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1935

C. C. WILLIAMS, President of the Society

As one writes 1934 for the last time, the 4 seems to resemble a column footed up with a line drawn and the account closed. As one picks up the five to put it in place, one is impressed with its resemblance to a ? reversed. Does not the entrance into the new year with so many strange vistas ahead raise some questions in our minds?

What will 1935 add to engineering education? What new movements will be initiated, what advances will be made in lines already established? We may expect another annular ring on the tree, but what buds will appear? Will dead limbs be removed and will pruning be sufficient to prevent sapping the growth of main branches?

What is the significance of the 20.5 per cent increase in the size of the freshman class in engineering in the United States; and of the 12.9 per cent increase in total engineering students as compared with last year? Are we to be faced with a corresponding increase in total enrollment as this large class advances and other correspondingly large freshmen classes enter?

Since codes and modern legislation regulating child labor prevent the employment of young men under sixteen, what will the youth of the land who do not normally go to high school do? Will they be forced into secondary schools with ultimately a due proportion entering colleges of engineering? Will other agencies than schools be set up to care for youth up to the age of sixteen? With youth barred from industry, what instrumentalities for accelerated industrial training will be devised to supply the needs? Will industries be compelled to amplify their personnel departments? Will engineering colleges be required to train men for such personnel work? To what degree will engineering colleges be called upon to aid industries in rehabilitating their personnel when the wheels begin to turn again?

Are public works established as a part of the national policy sufficiently to affect engineering education? Are college study and public works of a certain type the only kinds of dull season employment that government can pay for which yields social betterment and yet does not produce competitive goods that have to be marketed? Does study in college necessarily produce something that has to be marketed, or is it, like good roads, a benefit

that constitutes its own recompense? Is it more incumbent on colleges of engineering to find a market for their output than it is for colleges of liberal arts? Is engineering education merely one kind of education suited to students with certain aptitudes just as classical education is another kind suited to other aptitudes, both comprising a development of the student's capacities that will enable him better to adjust himself to the vicissitudes of life as he encounters them? In the phrase "engineering education," on which word lies the emphasis? Is there anything more certain in the view ahead than *change?* Can education, either technical or classical, confer greater benefit than to endow the student with the versatility and adaptability that flow from developed native powers? Is engineering education, contemplating as it does 20th century conditions, inferior to other forms of education that may be founded on the philosophies of by-gone centuries? Are colleges preparing too many engineers when, on all sides, engineering work sorely needing to be done lies fallow? If there should be danger of preparing too many engineers, is there any danger of having too many citizens with an engineering education?

In the century of its life, engineering education has never been confronted with more momentous problems than at present. Engineering educators of America will gather in council at Atlanta, June 24–27. Every trail to that attractive city is strewn with history and bordered by natural wonders and scenic beauty, in addition to affording panoramas and tableaus of many of the situations that bear on our problems. Helpful answers to many 1935 questions will emerge from the Atlanta Convention, either from the formal program or from informal conversations, if all attend and each brings his proper contribution of thought to be pooled, matched and checked with that of others.

THE ANNUAL MEETING, GEORGIA SCHOOL OF TECHNOLOGY, ATLANTA, GEORGIA

J. E. McDANIEL

Professor and Director of Co-operative Courses, Chairman of Local Committee

The Georgia School of Technology cordially welcomes the Society to its campus and to all its facilities which are needed to make the June meeting a success. Every member of our faculty will have a common purpose in making the convention members, with their families, happy and comfortable during their stay in Atlanta.

Perhaps some comment about the School and Atlanta will not be amiss, particularly to the members who have never visited this section of the South. The campus, which at one time was considered quite a distance from the business section of the city but which now touches the main arteries of Atlanta's commercial activities, contains forty-four acres. The twenty-five buildings are more or less closely grouped together. Registration will be in the armory, which is just being completed and which is only across the street from the three large, modern, up-to-date dormitories that are equipped to house comfortably over three hundred delegates. The dining hall, which is adjacent to the dormitories, is new and modern in every respect, affording comfortable eating facilities, both cafeteria and table service being available, for five hundred at one time. Plenty of lecture halls are available for the various divisional groups, and the chapel affords ample space for the main assembly meetings.

Headquarters will be at the Biltmore Hotel, which is only five short blocks from the armory, the dining hall, and the dormitories. This hotel will have rates from $2.50 up and is modern in every respect like everyone of the Biltmore group. It will accommodate at reasonable rates all who do not wish to live more economically in the dormitories, where a room for two may be had for $1.50 the first night and $1.00 a night thereafter. One dormitory will be used exclusively for the married people and their children.

The Georgia School of Technology, which is popularly known as Georgia Tech, is exclusively an engineering institution and takes especial pleasure in being host to this large, cosmopolitan group of engineering teachers and representatives of industries.

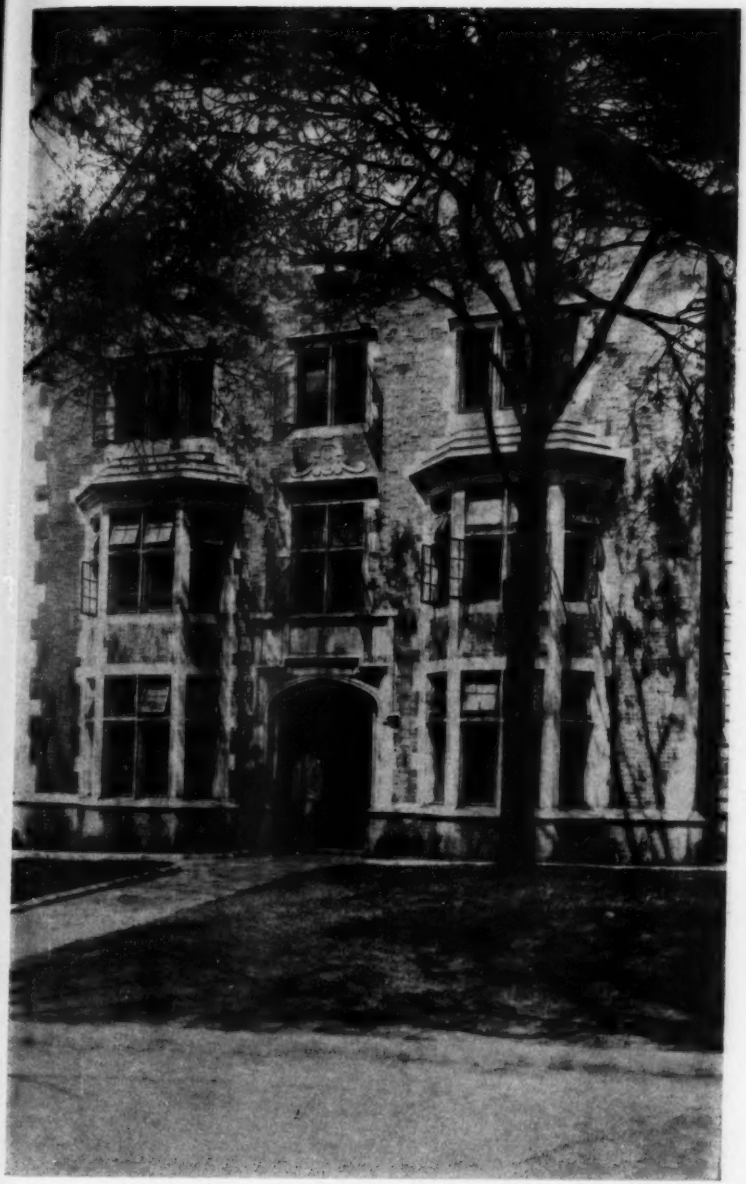
Its faculty is cosmopolitan, having more than one hundred and thirty teachers who hail from different sections of the United States. Its students, being about eighteen hundred in number, also come from different sections of the United States; even Georgia does not predominate nearly so much in enrollment as one might expect of this state institution.

Although in the council meeting at Cornell last summer some members believed Georgia Tech too far south for the convention in June, I trust that Atlanta, home of Georgia Tech, will have its usual June mean temperature over the past forty-four years of 76.1, and July 78.1. Atlanta is 1050 feet above sea level, having over the past forty-five years an average precipitation of 3.81 inches rainfall in June. Its cool evenings in the summer may be due to its location at the foothills of the Blue Ridge Mountains and its proximity to the Atlantic Coast in the East and the Gulf of Mexico in the South.

Atlanta is also interesting from the standpoint of its historical importance. From the year of 1843, when it was called Marthasville, honoring the name of Governor Lumpkin's daughter, it has been known as an important distributing center, being the converging point of practically all railroads of the Southeast, and being of nearly equal distance from many of the large cities east of the Mississippi River. It is 864 miles from New York, 720 from Cleveland, 743 from Detroit, 732 from Chicago, and 710 from St. Louis.

John C. Calhoun, statesman of South Carolina, predicted in the forties that it would be the national metropolis of the South. In 1864 the Federal authorities at Washington decided that since Atlanta was such an important focusing point of the Confederacy, General Sherman should by all means capture Atlanta. Consequently, the two famous generals, Hood and Sherman of the respective opposing sides fought most valiantly over the site of Atlanta, General Hood stubbornly and doggedly relinquishing foothold as he was being overwhelmed in numbers and could see only certain disaster staring him in the face. A vivid description of the Battle of Atlanta may be visualized now at the Cyclorama, Grant Park, Atlanta.

Thus, Atlanta should be very attractive to visitors. It is also more or less to-day the seat of the Old South, where one may see beautiful homes, country estates, numerous golf courses and club houses, the domicile of Joel Chandler Harris who became nationally and internationally known for his folk stories of the colored race. On the outskirts of Atlanta one may witness the lithographic carving of Confederate generals on Stone Mountain. Besides



JULIUS BROWN MEMORIAL HALL, RESIDENCE FOR S. P. E. E. DELEGATES

BRITTAIN HALL, DINING QUARTERS FOR S. P. E. E. DELEGATES

BRITTAIN HALL, DINING QUARTERS FOR S. P. E. E. DELEGATES

BIRD'S EYE VIEW OF THE GEORGIA SCHOOL OF TECHNOLOGY

CLOUDMAN HALL, RESIDENCE FOR S. P. E. E. DELEGATES

CLOUDMAN HALL, RESIDENCE FOR S. P. E. E. DELEGATES

NATHANIEL HARRIS HALL, RESIDENCE FOR S. P. E. E. DELEGATES

ARMORY, REGISTRATION PLACE FOR S. P. E. E. DELEGATES

Georgia Tech, visitors may find other educational institutions, such as Emory, Agnes Scott, Oglethorpe, and the colored colleges like Clark, Morehouse, and Atlanta University.

In the last census Atlanta had a population of over three hundred thousand, still being a great distributing center, though fast becoming more industrially inclined.

ARMORY, REGISTRATION PLACE FOR S. P. E. E. DELEGATES

SYMPOSIUM: MARKETING THE GRADUATE'S SERVICES

W. A. SHOUDY

Associate Professor of Mechanical Engineering, Columbia University

I wish I could agree with Dr. Wickenden that we had accomplished a great work in our efforts toward helping the unemployed engineer. I am not so sure of accomplishment except from one standpoint, and that is immediate relief for the engineer who was either destitute or pretty close to destitution, but I do think we have accomplished something else, and that is the introduction of possibly a new viewpoint to many of us.

Now, I am a rank amateur concerning this problem of marketing the services of the engineering graduate, or marketing the services of anybody, including myself. I was thrown into this work largely because everybody else had refused to do it, and I happened to be on sabbatical leave. I went into it green, except for the limited experience that all of us have had. Ever since we graduated from college we have at one time or another helped a man get a job. That helping has not been finding a job, it has been simply waiting until a job turned up and then telling our friends where to go. For thirty-five years or more, this has been the practice. As a man lost a job, all he had to do was to get in touch with his friends and someone among his acquaintances would, within two weeks to five months, find a place that suited him. Sometimes a better job, sometimes not quite so good. But during these past five or six years that kind of help has been futile because there were few jobs available.

The committee in New York worked to place unemployed engineers back into industry. It was organized about three years ago and was sponsored by the four founder societies. All of us from the very start were amateurs; all of us worked on the same basis that we had always worked, that of looking around to find an opening and dropping a man into that opening. When we found there were no openings, that there were no holes into which we could put these men, we found on our hands a large number of men who were facing destitution. Consequently our efforts had to be confined almost entirely to the immediate problem of providing food and shelter for capable men who had lost their jobs and lost their investments. From that standpoint the committee has done a marvelously fine piece of work, and is continuing to do it. From

the other standpoint, however, I am not sure that we have accomplished very much, except starting thinking along more fundamental lines.

Probably the fact that I am an amateur helped my thinking. I had no precedents to follow; I began to study where we might put these fellows, and my reasoning was something like this: As we look back over history, no matter how far back we go, we find the engineer. He was not called that, but he had the inquiring and inventive mind that found fire, invented the wheel, took control of waters, and built our cities. He was the foundation of the development of all industry. And we still find that the engineer, whether as the professional engineer or he who is doing engineering without being called so, is the keystone of industry. It is he who has been creating the jobs for the non-technical men. Now, if that is so I felt that here was a responsibility on our profession that we could not escape. If the engineer had created the jobs in the past he could do it again, and if we are going to come back to prosperity we are going to come back through the creation of new industries, and those new industries are going to be created by the engineer and by no one else. He will get help from others, but the fundamental idea is going to start from the engineer.

Another thing that I thought was fundamental was that practically every industry has started in a small way. No large industry has ever been created over night through the discovery in the brain of some man of an idea and then of his telling about that idea the next morning and immediately organizing a company to undertake it. Every industry that has amounted to anything is started in somebody's attic or cellar or in a small machine shop or laboratory and gradually has developed; and those industries, as I have said, have come from the engineers.

If that is so, let us do what we can towards encouraging the individual man to work as an individual, in the hope that he or one of his fellows may develop a new industry, and in that way provide a job for himself and more jobs for the general run of men.

We all know men who are constantly thinking up new devices yet have no ability to put those new devices into the form of a new industry. I wondered why, and I came to this conclusion: That the reason so many of these men can not put across their ideas is, they do not know how to get a job for themselves. Therefore, if the engineer is going to create jobs for others, the first thing he has got to do is to find out how to get a job for himself. As an amateur, I could not tell how to do that. So I hunted to find a man or men who could help me, and the first man to whom I appealed was Elliott Dunlop Smith of Yale. As an experiment we picked a hundred of what we called the A Class men, that is, those

who had formerly received salaries of $6000 a year or more, and called them together for a meeting. Professor Smith addressed them on the problem of finding a job. I was keenly disappointed at the results. We did get some interest, but not as much as I had hoped. In talking with one of the men afterwards whom I had known for a number of years, he said, "The trouble with this crowd is that they are punch drunk. They have been hit so many times they have gotten groggy and have lost their enthusiasm." This one man, however, went out and developed his own job and is taking care of himself at the present time.

I want to give you one illustration that has no connection at all with the Committee's work, but illustrates what one man can do. I had in my employ some years ago an assistant engineer who later left me, and went on up step by step until he was fairly well placed in one of the larger engineering organizations which folded up shortly after the depression. He had saved a little money, not much, and was thrown out at the time when engineering employment was probably the lowest. I could spend an hour giving you his personal experiences; some of them were very very unfortunate. Some months later, he came in to see me and said, "Mr. Shoudy, I think I have seen everybody in the metropolitan district who by any chance might employ an engineer and I have not found a job yet." I think he was telling the truth. He was one of these conscientious, hard-working chaps, and I really think that there was not a man in New York who ever employed an engineer who had not been interviewed by this young man. He said, "I am through. I am not going to ask for a job again. Unless I can present to a man a definite proposition I will not go to see him." Then we talked over different propositions that he might present, and a few weeks later he had developed a business of taking care of certain small power plants. I might say that this fellow had started out with absolutely no sense of salesmanship in his make-up, but when he started with a definite program to lay before a possible employer—he developed real sales ability and began to get a living and while he did not make an awful lot of money, he did hold his family together, kept out of further debt, and paid up some of his debts. Within this last month he secured a very satisfactory connection which will probably last him the rest of his life. That little experience with him convinced me that it was useless for this committee to go around and ask for jobs.

We had a group of ten or a dozen young men, all of them unemployed, who canvassed the entire metropolitan district looking for openings for the technical graduate. That work was kept up for two or three years, but the openings were so few that it is

hardly worth while mentioning them. We were doing only what the average engineer does. As one of my associates on the committee said, "When an engineer looks for a job he calls and says to the employer, 'You don't want an engineer, do you?'" And that is not much of an exaggeration. Now we had been doing very much the same thing, possibly not quite so bluntly but we were only asking if there was an opening. Consequently, I felt that we would have to change our tactics. In my hunt for experienced help, I found Mr. S. S. Board. I found him sympathetic, and he greatly helped the committee.

As the summer drew to the end, I began to realize that if our graduates were failing in the ability to find work for themselves it was about time that the engineering school helped them. At least our engineering school should help the graduate overcome these obstacles which he will meet later on in life. With Dean Barker's enthusiastic approval I leaned, again, on Mr. Board, who developed the course which we have been using at Columbia.

I wish I could list in just what particulars engineering graduates fail, but it is very difficult to write a formula that will cover human beings, for they fail in many ways.

I think the first point that we should mention is the fact that the average engineer has an inferiority complex. He does not realize how important an individual he is to society. I do not mean by that that we should give our engineering students swelled heads, but I do personally feel that the engineer is an almost indispensable member of society, and I believe that the average engineering student does not realize it. We have been satisfied with doing our job and not saying very much about it. I hope we will never get to the point where we begin to talk too much about our work, but we must not underestimate its importance.

With that inferiority complex the engineer is inclined towards saying, "You don't want an engineer, do you?" He seems to feel that he should not force himself on an employer, that to ask for a job means that the employer is going to do him a favor by hiring him. If we engineers are hired only because some employer is soft-hearted we had better quit being engineers. If we can not do a job for our employer, we had better get out of the profession. If we cannot make more money for our employer than he pays us we had better seek another job.

I believe that our engineering graduate does not realize his value to his employer but should see that the employer is not doing him a favor but the graduate is doing the employer a favor by working for him. If we can get him thinking that way then he can approach his prospective employer with the idea of selling him his services.

If I may be just a little bit personal—I was being considered for a job some years ago. I wanted that job pretty badly, and the decision was being held up. I knew there were half a dozen men after that job but I wanted it. Fortunately, I had a good friend who had no inferiority complex, and he keyed me up to a pitch which gave me courage to try to force the vice-president to make a decision. I said, "Mr. So-and-So, I am not inclined to brag about my own achievements, because, well, it is not good taste and you would not like it, but if I were selling you a steam turbine you would not think ill of me if I told you all of the superiorities of that steam turbine as I saw them. You might differ with me but still you would not think any less of me. Now I have something to sell you. It is not a steam engine; it is engineering experience and ability, and I want to talk to you just as if I were selling you a steam turbine." I got the job, and I got it that afternoon before I left the office. It is that sort of thing that I want to see the engineering graduate have, the knowledge that he has something of real merit to sell and he will then present a proposition to the prospective employer, not ask for a job. There is much more to this subject. All I am trying to do is to ask you to think along these lines.

When we came to develop this course our thinking was something like this: We want to teach our engineering students first, their responsibility to humanity. We want to get it pretty well into their minds, that it is they who are responsible for taking up the slack of employment in future years; that if they do not create the new industries, we will have an increasing number of unemployed, if only because of the increase in population and the engineer must take care of this slack.

Second, since the engineering graduates will have to create these new jobs, and inasmuch as there is a technique in job finding, unless he knows how to find a job himself he cannot teach another fellow to get a job, nor can he create new jobs.

The third thing we want to impress on our students is the joy of being an engineer, rather than being an engineer because of the salary. I do not mean by that that I think the engineer should forget his salary, but it has been my observation that the man that is getting the most joy out of his job is usually getting paid the most, because he puts more of himself into the job than he would if he did not enjoy it. Now, if we could get these boys to see the joy of accomplishment, the fun of the job, the fun of going through the petty details the early part of their engineering career, and building on it; in other words, if we can give them some idea of how to behave after they have gotten the job, we have started them along the right lines.

I am so enthusiastic about this work that I feel that it is fundamental. We gave this course to the entire student body so that all might start thinking. I feel that this training, call it job finding if you will, can start with the freshman class and carry on through the four years. We can start our freshmen thinking along these lines, and then finish the course in the last year before graduation with possibly the technique of job finding.

It was a disappointment to us that due to practical limitations of time, together with the fact that you cannot arrange things over night, it was impossible for us to adopt Mr. Board's course in toto. We had to condense it somewhat. We found only ten periods that were available, though he had suggested fifteen, and some extra time. I hope that we can carry on with that work along his lines, with such suggestions as might be offered here.

SAMUEL S. BOARD,

Yale Graduates' Placement Bureau, New York City

The course, "The Engineer and His Work," given this year to the engineers of Columbia, is Professor Shoudy's but, needless to say, I was and am in hearty accord with the plan. Much of the information contained therein has been given to engineering students in the past and is being given in various places. Undoubtedly some of the subjects discussed have been presented in lecture form many times but as we discussed the organization of such a course on a more formal basis last summer, there seemed to be distinct values in an orderly approach to the whole question. It seemed to us that the consideration by the young engineer of his professional advancement, whether in business, teaching or consulting, needed to start before he graduated, that there were certain basic conceptions needed which students did not always get in other classes and that the questions of types of work, the methods of obtaining them and the various problems of human relations and professional growth needed to be emphasized on a common sense and dignified basis. In order to be sure that the latest information was available various speakers were used, all of them able to speak with authority on their various topics.

In the main, the subjects covered were as follows:

1. The functional aspects of engineering.
2. The problem of selecting a field or a problem or a function which the young graduate could undertake.
3. Methods of obtaining work of this sort.
4. Problems of promotion and planned living after work is obtained.

Very few of us, probably, have gone through the last few years without realizing the urgency of considering the last two problems, even if we may have been disgusted with most of what has been said about them. It is not always realized, however, how much the solution of the last two depends upon a proper understanding of the first two. A good many years of interviewing, counselling and placing young engineers have convinced me of two things. First, that while we equip young engineers with information, and mental tools, which are the finest in the world, many of them know little about the actual circumstances surrounding their use and less about the art of working with others in the complex world of today. Second, that the very emphasis which is placed on ideas, materials and machines tends to make engineers disregard the human factor. The courses are hard and necessarily so.

There is little time for the embryo engineers to take part in social activities and many of them have had small chance recently to take part in actual shop or field work outside of their regular classes. Even if they do, these young men are likely to be absorbed in the mechanical problems presented instead of the human ones. It was, therefore, with the double problem of presenting, first, the functional aspects of engineering and, second, the human relations involved in these, that the lecture course was set up. The results speak for themselves. Attendance was respectable and was maintained without any compulsion to the end. Practical results were evidenced in a much more enthusiastic and yet more sane approach to the question of getting a job.

Since this was, frankly, an experiment and, naturally, will be improved another year, the three suggestions which I am about to make may seem unnecessary. I am taking this opportunity, however, to answer in advance at least two points which might obviously be made by the discussers. In the first place, if they suggest it I would agree immediately, and I think Professor Shoudy would, that the course would profit by a review or carry over from lecture to lecture, which should be given by the same person throughout the course. It is difficult to arrange lectures given by several different men so that they are uniform or continuous in thought, even though the course may be organized on that basis. There are bound to be differences of point of view between the lecturers, and that is a good thing. It may, however, be somewhat confusing and an intelligent summary each session of the preceding talk might help to fix the continuity in the men's minds and give the current lecturer a better idea of what has gone before. It would be possible, of course, to have lectures prepared and written in advance but such a method tends to hamper the lecturer in his attempt to interpret his subject to the class, it robs the lecture of

some of its color and it is extremely difficult to get busy men to do it. A summary, therefore, would seem to me to help. This might be provided by students in attendance or by a committee of students but should be brief and I believe should be carefully scrutinized by some one, in this case Professor Shoudy, before being presented. There are various other ways of meeting this problem which need not be discussed here.

The second suggestion is concerned with the development of a correlated and accompanying reading course. A beginning in the organization of this was made last summer, but, frankly, I was dismayed at the paucity of text book material suited to the college level. A thorough investigation might result in the discovery of a good deal in current periodicals which could be used, and there are new books coming out all the while. I have been asked to review several on this subject, however, recently and I have not been greatly impressed. The fact remains that a carefully prepared bibliography and reading course would do a lot to authenticate the material offered in the lectures and to clarify, I hope, the inevitable conflict of points of view.

My third suggestion would be that participation in the activities of the course be increased as much as possible. If attendance at individual lectures is voluntary it is probably impossible to insist on required work to be handed in but it might be possible to organize an informal discussion group at the same time and the course could be extended to include actual demonstrations by the students as to methods of carrying out their own programs for settling the vexing question of which way they are going after commencement. The final dinner at which certain men in attendance at the course were invited to meet with Dean Barker, Professor Harrington, Professor Shoudy and those of the lecturers who could be corralled at the time (the rest seemed to all be in Washington) offered to me at least a very clear indication of the value of group discussions throughout the course. There are practical difficulties in the way of this but none of them seem to me to be insuperable.

As a final word I should like to outline briefly a study made several years ago (1926) of the relative stability of academic and scientific students at Yale. A cross section was taken at a given date of those applying for work at the graduate placement office. The difference between the two groups was striking. The academic graduates applied in about the same proportion for the first five years out of college, then there was a gradual diminution of the number at a rate which resulted in a pretty smooth curve on the chart. The number of scientific men applying for work, however, was markedly greater about every other year for ten years

and then the same diminution occurred. It does not seem right to me that it should take twice as long for engineers to settle down. Maybe it is purposeful and the result of their desire to gain a variety of experience but the years of interviewing and placing which have followed the making of the study have made me feel that it is more likely ineptitude in adjusting themselves to their job and lack of any real plan for professional advancement. Increasing contact with other engineers has also led me to feel that this situation is not peculiar to Yale alumni. The work of the Engineers' Council of Professional Development which is charged with the task of aiding professional advancement, will undoubtedly help to correct this situation but I believe it might better be prevented and that the course under discussion will help to prevent it.

A. D. MOORE, Professor of Electrical Engineering, University of Michigan

People can stand up under a terrific amount of bad news provided it is to their own interest. I am referring here to the simple matter of our needing to be truthful and intellectually honest in dealing with the unemployment problem when it occurs.

About two years ago I had an opportunity to give a series of radio talks over the University's broadcasting system on the unemployment situation. It was not labeled "Getting a Job" or "Hunting a Job" or anything of the sort; it was labeled "The Unemployment Situation," for that is what the situation was; and at that time, knowing that certain unemployed engineers and others were making efforts that were futile, one of the main points of emphasis in those talks was to plead with all who might be listening and who were unemployed to save every nickel they had, use it to live on, and not spend it running around the country or even putting stamps on envelopes in a vain effort to hunt a job that was not there. The listeners, whoever they might be, were advised to retreat as gracefully as possible; if they were young, go back to mother, where they could eat; if they were older, work it out in some other way; but to save those few remaining dollars and not chase a job that nobody was finding, because there was none to be found.

Instead of being overwhelmed with reproaches for being so pessimistic as that, the reactions were entirely opposite, even to our getting letters from a stenographer who had already found that that was exactly the course she had to pursue; and many others likewise.

At that time our seniors were specifically and repeatedly advised not to graduate and then begin writing letters to this, that and the other company. They were told of one of our graduates

who had already piled up a beautiful list of 55 replies from companies, all to the effect that they did not need him just now, and all of which he might have known before he wrote his 55 letters. In other words, if these people are told, under whatever circumstances may prevail, the facts as you may be able to see them, and if they believe that your analysis is correct, they will thank you for it, even if the news is bad.

That we agree wholeheartedly with the efforts made by the New York men who have talked will be indicated by what I may say about our own efforts along these same lines. The activity described here is certainly splendid, and all we may say of it is that we wish it may be extended everywhere and along very much the lines laid out.

The job of the school has, of course, to do with the student; later, with the senior who is about to graduate; and later still with the men who already have gone out. It is a three-barrelled problem.

One of the things that we want our men to do is to fill out for us in the Department of Electrical Engineering a personnel record card in the senior year. That card is quite modest, not at all comprehensive. It simply amounts to minimum information, and its size is 8×5. We believe in accessible, highly useful information, rather than in extended records; and incidentally, any school which builds a personnel record system of wide scope which falls down when depressions come along and removes the budget appropriations for such activities is, I think, heading in the wrong direction. Instead I would plead for the simplest possible kind of record system, but one that can be maintained throughout and can be used when it is most needed.

In connection with the personnel record card which the man himself fills out by coming into the office, the interesting fact is that year after year it is very difficult to persuade a goodly number of seniors to come in and fill out that personnel record card, even though they are somewhat repeatedly told that it is largely to their benefit and not to ours to do so.

The card is used for the man's benefit during his senior year. We know who he is, how to find him, and so on, but in addition to that, he knows that it may be used for his benefit afterwards; and yet, in spite of all that, it is difficult to get some of our seniors to coöperate by filling out that personnel record card. The significant fact about it is that when we study the personnel record cards about at the time when half of them have been filled out by the seniors and then study the scholastic records of the men who have filled or have not filled out those cards, year after year it comes out that by and large and with few exceptions, the worst men in the class scholastically are the men who do not coöperate in this

respect. That is exactly as any sane person would expect it to be, I believe, and it indicates that the man in general who is not doing well in his college course is, for various reasons, also not going to do well by himself. There are notable and remarkable exceptions to the rule, but as a generality it has turned up so often that I am afraid there is a great deal of truth in it.

We can, of course, go astray very easily by putting forth tremendous effort in the colleges to reconstruct and revise and do things for the man who is in the lower ranks in the class and in the lower ranks in personality and initiative and effort and vim, and so on. I think we can go much too far in those respects. There are only so many hours in the day and by and large our efforts should be pretty largely spent in helping the man who is willing to help himself.

One of the other activities that we have carried on for some years is what we call the preliminary contact program. It was devised for a reason totally different from that which now prevails for carrying it on. About 1928 or '29 we were finding that when companies would come to the campus to interview electrical engineers it was becoming quite difficult to get electrical engineering students to go to these interviews. They were uninterested. They all thought they had jobs, maybe five or six jobs apiece; and if a student was not definitely interested in this recruiter's program he just did not go. In other words, we had to find a way to make those men job-minded in a time when there were too many jobs. Out of that came the idea of a preliminary contact program, by which four selected companies—in our case, G. E., Westinghouse, A. T. and T. and the Detroit Edison Company—would come to us in the first semester with a speaker and possibly with men for interview purposes as well; but this whole business was not a recruiting program at all, but a contact program, by which someone from the A. T. and T., for example, might come, talk to a meeting held under the joint auspices of the student branch A. I. E. E. and the department, and hear a man from the telephone company or the Western Electric, or what not; and likewise from the other three companies.

We cannot say that the program was at all comprehensive in covering the functional types of engineering, or anything of the sort, but it helped, and the interviews were conducted simply to create an opportunity whereby these men in the first semester under non-recruiting auspices might go in and ask any questions they care to of the interviewer.

Soon after the plan was initiated the depression came along, and we have liked the plan very much because it has enabled us to ask these companies to continue to come under conditions when

they might not otherwise care to come at all. They have not had any jobs to offer in the last three or four years and, therefore, why should they come to conduct recruiting interviews when there was no recruiting? But under the preliminary contact program they have come just the same. We thank them very much for it. They have given these talks, they have held interviews fully equal in scope and length and time and energy to the interviews they used to hold, and it amounts to the boys having a direct opportunity to inquire of industrial representatives what the game is like, even though there are no jobs around. The companies have been a little bit hesitant, two or three of them, about carrying out this program, feeling that if they had nothing to offer the situation may be so pessimistic that the boys might not react favorably to it if they simply have a chance to interview. The reaction of the boys, I should say, has been entirely favorable, and I hope that we can continue the enterprise.

As a part of this same general program we hold in the department once a year what we call the job conference. It is fully advertised for a good many days in advance and the men invited to it are the junior and senior electrical engineering students and graduate students, and anyone else who may want to come. It has become an annual event. When that is held, at seven-thirty in the evening, we usually have a number of men present, at least equal to the size of the senior class in electrical engineering, and the floor is almost immediately thrown open to questions. From about seven-thirty to ten-thirty or eleven o'clock all kinds of questions are thrown into the hat by the students and answered as best they can be from the platform.

One of the frequent questions, for example, in that session is, What about the small company versus the large? If there is any one question that a senior has on his mind it is that. I invariably counter by asking the senior who asks it, will he please name six small companies with which he would care to become associated? No senior ever has done so. I cite that simply to show that the question he has in mind is, so far as he is concerned, almost entirely academic and it indicates that he ought to get better acquainted with some of the small companies and some of the larger ones.

One of the questions asked just the other night always comes up—this was asked in the job conference: How to approach the employer? We were covering many things that evening and the reply I gave at the time was not sufficient, not full by any means, and it may seem to have turned the question aside, but the answer was this: If you as a senior do not already know how to approach your present employers, namely, your faculty members around

here, you are not going to find out how to between now and the time you graduate. In brief, doing things with seniors is doing them too late in connection with matters of approach to employers, and so on. It should be done, anything we can do ought to be done, but the time to begin that kind of thing is back in the freshman year.

We do make some efforts along those lines in terms of a freshman assembly once each week for all engineering freshmen. It is a wonderful opportunity. We try to take full advantage of it, and many things go on there which I cannot possibly outline in this session. But I think the college ought to be concerned with this idea more than it is, namely, that life does not begin after college is over, but that college is a part of life itself, a very important part of life.

A student should realize very early that things are not going to begin at the end of graduation but they have already started for him in a very large way; that the job does not begin at the end of graduation but that the job is on right now. He is the engineer, the faculty man is the boss in many respects, and if those relationships between the boss and the student and between one student and another are not satisfactory in college there is little hope of their ever becoming so after college. I think those viewpoints need to be emphasized and worked upon more than they are.

One thing I should like to mention here is the question of whether to have a centralized or a decentralized placement bureau. This, I believe, is the place for those questions to be discussed if they ever are going to be discussed. I will give you my feelings on that, based on a number of years in the employment and placement game, and you can take them for what they are worth and disagree with them if you like. That will be all right with me. But with proper exceptions being made for different situations here and there, I believe in the departmental placement activity. I do not believe in a department's selling out its rights and responsibilities in these affairs to a centralized placement bureau.

Now, that statement can be easily misunderstood. On our own campus we have, for example, a centralized placement bureau, but it is concerned largely with non-engineering activities. It is doing a fine job for literary students and I think it is the right answer for that group and for other groups, but for engineering we ourselves know, or should know, our industries. The department knows the industries concerned with it, it knows its students, and if there is any one thing that a recruiter or an employer who is far away and who is writing in wants to know, it is not only what is the man like himself as to his record and so on, but what is the

opinion of the faculty members most intimately concerned with that man; and anything that gets in the way of that direct line, three-point contact between employer, faculty member and student, is not, in the long run, I believe, going to help as much as it may hinder. I believe, therefore, in the department in some way or other becoming actively responsible for this work and carrying it on.

S. B. EARLE, Director, Clemson College

Until within very recent years it has been so easy for all of us to market our product that most of us have given little attention to this phase of our educational training. The needs in industry for men with engineering training developed more rapidly than our colleges could furnish men to supply these needs. A number of the better men were spoiled by the number of offers they received and many who went to some of the larger companies for further training were handicapped in after life because they did not complete the course because of the temptation to accept more responsible work at a considerably higher pay. It is natural that engineers should feel the depression more quickly than almost any other profession because so much of the engineer's work is of a creative nature which does not necessarily have to be done. Building of all kinds is one of the first things to be curtailed and naturally this affects much of the manufacturing where engineers are employed. I consulted with Virginia Polytechnic, North Carolina State, Georgia Tech. and Auburn, and while the figures I am about to give are in no sense averages, I think they are more or less representative of these institutions as well as my own. Before the depression 80 to 100 per cent of our graduates were placed before graduation, many of the better ones having a number of offers and during the summer following graduation, nearly all the remainder found work. From 40 to 90 per cent were employed by representatives from various companies who visited the institutions and the remainder either found work for themselves or were placed through efforts of the college, some in the state and others outside. The number placed in the state depends on the state and the kind of engineering the graduate has taken. The industry in the various Southern States differs from state to state, though in nearly all considerable highway work has been carried on, so that a great many of the civil engineering graduates have gone into that line of work.

Because of the relatively small amount of engineering work in parts of the South (and this is particularly true in South Carolina) a large proportion of our men were employed outside, par-

ticularly those who took the mechanical or electrical courses. In more recent years many of these men have returned to this state as engineering has developed and it has also been possible to place more of our recent graduates in the state, particularly with the power companies. As most of you know, we have a number of larger power companies in this section of the country, all more or less inter-connected, which provide a large amount of available power for industrial expansion. Recently the Saluda Dam has been built with the capacity of around 200,000 kw. This development is on a comparatively small stream and depends for power largely on holding the rainfall, particularly the heavy rainfall in the drainage area. The dam is of earth and the reservoir is as large as Lake George, being over 500 miles around the water's edge. There is also another development in South Carolina which is being pushed at this time; namely, the Santee-Cooper Development which will also have the capacity of around 200,000 kw. This is an unusual development, in that the Santee and Cooper flow nearly parallel but from the point where the old canal went from one river to the other, the Santee has, because of the silt deposit, and the long path between that point and the sea, raised the level some 60 feet or more above the Cooper river. It is planned to divert considerable water from the Santee to the Cooper for this development.

In the last few years the placement of our graduates has been quite different, a very few of the graduates being placed through representatives coming to the colleges, and a large percentage has not been placed at all before graduation, though many have received positions during the summer or during the year following graduation. Many of these however have not received positions along engineering lines.

While the engineering colleges have not in any sense guaranteed a position to their graduates, I think most of them have felt considerable responsibility in the placing of them especially in their first position. I feel that this is entirely proper but in addition to this, I am sure we have other responsibilities as well. I think we have a responsibility in the selection of our material, choosing in so far as we can that which can be developed with proper training while in college so that we will be in position to market it upon completion of the college work. I realize that it is not possible to make a very careful selection before entrance to college, so that I feel it is our duty during the first year and also the second year to make a careful study of the men and make eliminations if necessary. These eliminations should be made as early as possible before the material is spoiled. Many of these men can shift to something else and make a success but we must realize that the

period of years in which the college education is obtained is very short and unless the average student gets his training during that short period of his life he is not apt to get it at all. With most of our Southern institutions, our material comes largely from rural communities. It is said that one-half of the rural population is in fourteen states. Most of these men do not know much about what engineering is. Our responsibility therefore is probably greater than that in some other sections of the country. Like steel, these men are not all alike but those selected and when properly trained can be made to fit into some kind of engineering work —naturally the higher quality in more responsible work and with higher pay.

Once having selected our material it is our duty to plan a course for the student which if properly pursued will cause him to develop those qualities and characteristics necessary for the engineer. He must be taught to think and think straight and logically. Naturally it is necessary for him to be trained in mathematics, English, history, mechanics, materials, etc., and learn something about the application of these in the engineering world. He must build a foundation which will carry a building he will later want to put on it. Of course this foundation must be strong but the shape of this foundation is also important and in order to know something about the shape it is necessary for him to know something about what the life of an engineer is like and something about what he may expect for the future.

Besides the teaching of the so-called strictly engineering subjects there are other things which are quite as important if we are to turn out a product which will sell and which will advance. *First,* I would mention character. While the training of character should begin in the early years of life, it certainly may be strengthened during college training. While character may not be taught from a book, our students should have the proper surroundings and our teachers should have such personality and personal character as to influence their students and strengthen their character.

Second, neatness, both in written work and personal appearance. We have found that this has been greatly stimulated by military training. The effect of neatness is very marked when the student makes his first interview or when he is later interviewed for a promotion. A boy who stands erect and can look the interviewer in the eye and is courteous is much more apt to make a good impression. I would also stress the need of the development of self confidence and initiative. I am afraid that our training along these lines is not as good as it should be.

Third, the ability to meet and get along with people. The engi-

neer no longer works with material only but must also work with men. While there may be some objections to dormitory or barracks life, I am sure that there are also many advantages. It is very democratic and the boys have to learn a lot of human psychology whether they want to or not. I am sure that this has been of great assistance to many of our graduates in their life after graduation.

Fourth, Interest in other things. I think we should encourage the student to read and keep up with the times and be able to talk on other subjects than engineering. He should be stimulated to take an interest in what is going on and also an interest in the community life. I have noticed particularly that one representative who comes to our institution who I think can size up a student in a short time better than any other I know, does not spend his time finding out about the student's strictly engineering ability, but tries to get the student to talk on other more general matters.

Like any manufacturer who expects to stay in the market doing the same business for a long period, we should develop a *good product* and keep it *consistently* good. We must hold up our standards, changing our products if necessary from time to time to meet varying conditions. From time to time it may be necessary to establish ourselves with new organizations by placing a good man with them with a hope that they may continue to use our product. It is particularly necessary in this case that we select the right man who is sure to succeed with them. I recall a great many years ago now, that one of the larger companies did not take our men directly on test but put them in the drafting department, many of them later being transferred to tests. One year we had a student who had been a merchant but was greatly interested in engineering. When about 29 years old he came to us for engineering training. He was greatly interested and developed wonderfully and when he finished we pursuaded this company to take this man directly on test work. The next year when we wrote them to see if they desired any of our men, they told us that they would take the whole class if they were like this man, and anyway would take six. Since that time they have been taking our men regularly.

We should try to make our product so good that others who have not used it may see how good it is and may desire to use it. I have been particularly pleased to make some contacts in this way. In times like we have been passing through when the larger companies take so few men it is necessary to develop other connections. A survey should be made of the smaller companies throughout the country and particularly of local concerns who use

engineering men and also of those concerns who could use them but may not have been doing so. I would call your attention to what has been done by Case School of Applied Science along this line.

In this section of the country a large percentage of our population has been rural. It is true that the Piedmont section has developed the textile industry until we have now in this section a very large industry. Our textile schools supply a lot of men to this industry, not so many in strictly engineering work but more from the standpoint of room bosses in spinning, weaving, etc. There is a field however in these mills in which I think we should interest our mechanical engineering graduates. Most of these mills have what is known as a master mechanic who in the past has been largely a repair man and who received his training by the apprentice method. He is often a good practical man who can keep things going but is of little use when it comes to improvements or developments or changes which will improve efficiency. The pay for this type of work is excellent and I see no reason why some of our mechanical engineering graduates should not get into this line. They may have to start in as an assistant to one of these men but it should develop into something worthwhile as the years go by.

One of the regrettable things to me has been the fact that so many of our men have left the state. I believe that one of the goods that the depression will do will be to stimulate the development of a varied industry in our state. We should not be dependent wholly on the textile industry but should develop a varied industry just as we develop diversified farming. The salvation of our farming I feel is the development of industry along with agriculture. This will furnish a local market for what the farmer produces. I am glad that we have shown considerable progress along this line in the past few years. In our own state such industries as the Taylor-Colquitt Company, a large creosoting plant, and the Aldrich Machine Shop, which really does manufacturing work, have been developed by Clemson graduates. We have excellent clay in this section which offers considerable opportunity in the manufacture of tile and brick. We have one brick concern in Sumter, S. C., which has developed a special brick which has been sold for special uses all over the country.

Not only must we market our product but some thought also should be given to promotion. Great care should be taken however in this connection as too many are more interested in promotion than they are in their work and have not the patience to wait as long as they should for promotion. Sometimes too early promotion is very detrimental to their future advancement. Too

often because of financial reasons, it is necessary for a man to seek a higher paying job when there is very little future to it. I believe that there is some need for some such course as has been outlined and if properly carried on will be of great benefit to our students. Care must be taken that too much time is not spent on such training that will prevent the student from receiving sufficient training to enable him to hold the position after he gets it.

We might liken the training of an engineer to the building of a residence. The proper material may be selected and the building built strong and substantial but when completed it may not be attractive or convenient and hence would have no sale value. Using the same material and with approximately the same amount of money another building might be erected which would not only be well built but at the same time would have conveniences and a good appearance and would be salable. In some instances more of the money would have to be spent on foundations than others depending on the location. The same is true of our students, much depends on the background of the student. When received with a proper background it may be like with us building on our red clay, where very little actual foundation is necessary because of the character of the subsoil. Conditions vary throughout the country, but we must all realize the fact that our engineering training should be well rounded and not consist wholly in what may be called strictly engineering subjects.

We must realize when we are selling our product we are not selling a finished product, but only one which after the training we have given indicates he will develop into an engineer. Some of the men may not be such men as to develop into an engineer in the strict sense of the word but it should be possible for him to fit into some kind of engineering work.

There has been a falling off in the number of engineering graduates to some extent. We have not suffered very much along that line. There is also a great falling off in jobs. I think there is going to be keener competition, not only in the engineering graduates but also in all graduates of institutions, and I think that makes it even more necessary that we develop some such course as has been outlined here, and it should be more effective, I think, as it is further developed.

Summing up, then, I would say that we should give great attention to selection. If possible, we should teach the high school principal something about the kind of boy who will be suitable for engineering training and get the high school boy to know what engineering is so that he will know whether he will like it or not. If we cannot get to the high school, early in college we should let the boy find out what engineering is and see whether he wants it

or not. Let the faculty also see if he is the proper kind of material and eliminate him as soon as possible if he is not so he can get into something else.

We should try to develop neatness, character, interest in other things, and especially try to stimulate an intellectual curiosity in other things as well as engineering.

We should give sound training in the fundamentals by a faculty that has personality and that will attract the students and stimulate the development of their character.

We should hold up the standard of our product and try to develop new fields for the use of it.

I think we should teach the student to help himself and that is one of the many things in which this course may be of great help. Probably in the past the faculty has done too much for the student and the student has not been developed to rely on himself.

Whether we can get for the engineering graduate a position along the line of engineering or not, I think we should realize that we have given him a training which will be of great help to him in his life work whether it be along the lines of engineering or some other line.

O. W. ESHBACH, American Telephone and Telegraph Co.

New York is looked upon as the center of many activities and because of it, is frequently regarded as a place where at least something is available in the way of employment. Yet by the very fact of possessing the greatest population density it likewise has the greatest unemployment problem. The unsuccessful callers at its many industrial employment offices are indeed many and clinically represent interviews with almost all types of individuals. Our Chairman has emphasized the value of examples of such contacts and I should like to give a few which from the viewpoint of age and experience distribution substantiate what has been said by the speakers about the necessity of helping applicants in the technique of job hunting. I think we all appreciate the reality of what has been said and look for helpful suggestions from actual experience.

My first story goes back a couple of years to the beginning of the depression, when a man, relatively old when we are talking about students, 55 if I remember correctly—came into the office. His son was employed by our business. He was a successful mechanical engineer, experienced in the design of pumps. He worked for a company and he had given his life to it. In the process of reorganization he was laid off. His approach was "Somewhere around here there is somebody who can help me in

my thinking. If I may, I would like to talk to you a little while." We talked for about two hours, and in that discussion about all that we did was to bring out and analyze salient facts. He came back later on and he said, "I have the answer. I am going to make a business for myself and I am going to be content. I am contacting all of the firms that might use mechanical appliances of the nature of pumps and turbines and things of that character, and I am setting up a sales agency on a commission basis, and if I can get $50 a week I will be satisfied."

Here is another example, which in contrast is pathetic, and I mention it only because I think it is so very important. It seems to me that it is almost impossible that a situation like this could exist, and yet there it was. I know it is not typical of the institution. It was just an oversight; it just happened.

One of the teachers called me, and said, "I would like to have the valedictorian of our class come over and see about a job." Now, this is the boy's story: He was the valedictorian of the class, an excellent student, and a nice boy. His father had died when the boy was about fifteen years of age. The mother had sacrificed about all of her income except what they needed to support themselves in modest circumstances to put this one boy, who was the only child, through school. He lived at home and his association outside of his family connection was in a very narrow circle.

During that boy's entire career apparently the idea that he would have a hard time getting a job never entered his mind. He worked hard and was very successful in the job at hand, namely, getting his education, and he thought that that, of course, would get him a job. Normally it would. He could not believe at first that there was not a possibility of his employment in our business. And he could not believe there was not a job somewhere else, some place he could go, where all he had to do was apply. He had not contacted a single firm, and I do not believe he had given any serious consideration to employment prior to perhaps a week before graduation.

I should like to emphasize the approach to helping people by a self-analysis of what they are able to do and selling the particular things that they can do, for it seems to promise far better results than just the haphazard method of sending people out to get jobs by pulling doorbells.

E. J. FREUND, Dean, University of Detroit

It has been suggested a number of times this morning that the smaller industries offer the best opportunities at the present time. To this, I believe, we may well fasten the principle that a man

will ordinarily make the best impression—or at least will most easily make a good impression—in a poor situation. I think you will all agree that a very considerable minority, if not a majority, of our important American industrial figures have made their first deep impression by a successful effort to revive some broken down corporation. Can we not apply that fact for the benefit of the younger men of whom we are talking today?

I am sure that in almost every little Midwestern town, about 100 yards or 200 yards back from the highway, down on the bank of a little creek or river, you can find some little old shop which is probably still in operation only because it has been written off years ago. You know how those shops look, the walls are awry and burlap has been stuffed into windows where panes have not been replaced. That is not an especially desirable place in which to work, except for the type of lad who can be made to see that the revival of a decrepit institution offers a great opportunity.

I think that if our boys will go into the small towns and help the owners and managers to rejuvenate these small industries, they can make a better record in the profession and can grow up sooner, so to speak, than they can in the big, splendidly organized institutions which we naturally take very seriously.

Imagine the start of a young engineer who gets into a little town of a few thousand people. At first he may be looked upon with some little suspicion. He learns to understand the character of the men who own and operate the small industries, old time mechanics and artisans who have gone into business. He deals tactfully with them and gradually wins their confidence and sympathy. Then he applies in the small shop, in a thousand obvious situations, the things he has learned in school. Conditions in the business are bound to improve and in the course of a year or perhaps three or four, the young engineer becomes a man of some consequence in that community.

Of course small town life does not appeal to the average young engineer. But small town life is no longer what it used to be. Yesterday afternoon I sat next to one of the professors of Cornell University who spent fifteen or twenty minutes telling me how pleasant it is to live in this rural community, as he called it, and away from the big cities. He pointed out to me that because of rapid communication and rapid travel, there is no longer such a thing as isolation, and that living in a small town is just as delightful, or more so, than living in a big town. If our young men can be made to see it that way, perhaps we can find thousands and thousands of openings of which we have never thought before.

Have we not been so dazzled by the brilliant achievements and the brilliant organizations of the large corporations that we have

neglected to look into the highways and the byways to see what we could find for our boys to do?

PRESIDENT WICKENDEN

I would like to reënforce what Dean Freund has said. A year ago when we at Case turned ourselves into a mutual job finding association, we asked each of the departments to supply us with a list of the concerns in and about Cleveland which had hitherto employed none of our graduates but of which they had knowledge. Our Department of Chemical Engineering supplied to that job finding association a list of 225 concerns manufacturing or distributing chemical products in that region, not one of which had a chemist or a chemical engineer.

There is a vast ore body under the surface which we have not touched and not scratched, and it is in the discovery of that thing that much of our expectation lies.

C. C. WILLIAMS, Dean, University of Iowa

When a boy graduates, of course the comfortable thing for him to do is to attach himself somewhere so that a monthly pay check comes in at the first of the month. However I am inclined to think that we have not exploited sufficiently the opportunities that lie along the line of finding new opportunities for these young graduates, perhaps in new industries, in small towns. I shall mention three illustrations which exemplify the thought that I have in mind.

In 1908 jobs were difficult to find, as they have been in the last few years, and a graduate of the college that I represent, a little over a month after he graduated, organized a washing machine company. There were three boys in the company, and I suspect they caused some smiles to appear on the faces of their friends when they gave their company the rather high-sounding title of the Automatic Washing Machine Company, and designated themselves as President, Secretary and Treasurer respectively. However, that company lived and became a million dollar corporation, able to compete with the larger manufacturers of that particular product. It was a time when washing machines, of course, were new.

Another example: A boy who graduated, I believe in 1915 or '16, went to his home town, a small city in Iowa, and established a re-built battery business. He began to canvass the countryside for the carcasses of automobile batteries. He rebuilt them and was able to compete in the market in second-hand batteries. Times became a little hard, some five years ago, and he had been experimenting with a formula for soap. He began to make an automo-

bile mechanic's soap, not just a soap, but an automobile mechanic's soap. I am not on his payroll but this was a soap that would take off the grime and dirt, so he said, and I think it is true, and leave the hands in good condition. In my office about a year ago, he said that he had about 40 employees, and that he had not been compelled to reduce his force nor to reduce wages of anyone. That was a rather remarkable record for these years.

Two years ago three of our boys organized the T. M. C. Engineering Company. Those letters are the initials of the boys. They did anything that anybody in the community wanted done. They would make blueprints, help someone with a heating problem in the house, or do almost any other kind of local job that they could get to do. One of them established a connection in another state and soon drew the other two into it. So they are going along pretty well, although the original company has been practically abandoned. Last year two of our boys established an industrial photography business. They had a flair for photography, and just within the last month have taken an office on North Michigan Avenue in Chicago. They have enough regular business to pay their rent and a little over, and they have a good opportunity for commissions on the side.

I do not know how many of these little businesses will survive ultimately, but some of them probably will. I am inclined to think that our state institutions particularly justify their existence to a certain extent in building up the industries of the state, and I think that we might do well to encourage our graduates to undertake small businesses of this sort, rather than to be dependent entirely upon the large and well-established businesses.

M. G. MALTI, Cornell University

Three questions occur to me which I would like to ask. Before asking these questions, I would like to state an example which is already familiar to you. Some time before 1929 the manufacturers and the moguls of industry found that goods were not moving fast enough. So they called a bunch of experts together and asked them what to do about moving those goods. The experts said that was the easiest thing in the world. All you have to do is to pretend that you are giving away the goods. Tell a man that he could have a radio if he only paid $1 on it; tell another fellow that he could have a refrigerator if he paid $5 on it; and tell the third fellow that he could have an automobile if he paid $25 on it. Of course the goods moved, and they moved fast. Indeed, nobody could hold them from moving. Well, finally the crash came. You know the story.

It seems to me we are in just that position now. We have the experts with us who tell us that in order to have our graduates located, we have to teach them the art (or science) of securing jobs. We have to offer courses in the universities covering this topic. Please note the analogy between our trouble and that of the manufacturers of 1929, also between the remedy suggested to these manufacturers by their experts and that suggested to us by our experts.

We are overproducing a human product called Engineers. They were overproducing material products of all sorts.

They were at a loss to know why their products all but ceased to sell and were frantically seeking *a* cause, *a* remedy, *an* explanation—notice *a* cause, not *the* cause, *a* remedy, not *the* remedy, *an* explanation, not *the* explanation. Some of us here are at a loss to know why our products (our graduates) all but ceased to sell (to find jobs) and we also are frantically seeking *a* cause, *a* remedy, *an* explanation.

I have no doubt that some of the advisors of the manufacturers knew *the* cause and its remedy and stated them in no uncertain terms. But they were bitter facts and our moguls preferred not to believe them. Moreover, they were willing to try anything that sounded plausible, any palliative that was sugar-coated. Hence the popularity of the so-called economic experts of the Coolidge era. Now right here among this audience there are men who know *the* cause and the remedy of our trouble. It is this! *We are producing too many engineers.* There are not enough jobs for all our graduates. This, however, is a disagreeable fact to face. We would rather not believe it. We would rather have the experts give a different cause than overproduction. We would rather have them say that the market is there if we only went after it just as they told the moguls of industry that the market was there if *they* only went after it. We would rather have them say that what we need is more courses in personality rather than less personalities in our institutions just as the moguls preferred to have their experts say that what they needed is more production, more high pressure salesmanship and more advertising rather than curtailed production, low-pressure salesmanship and less advertising.

The reason for this attitude is obvious. *The* remedy meant immediate curtailment of activity and consequent financial and human suffering. *A* sugar-coated remedy eliminated all these disagreeable features. But, alas it was not realized until too late! The result was a crash never equalled in history, accompanied by most violent financial and human suffering.

I believe that it would be an exceedingly short sighted policy to listen to our experts diagnose our trouble and suggest their

sugar-coated remedies. We do not want the experience of the industrial and financial moguls repeated in the universities. We should face the facts and affect curtailment before we are forced to engage in still greater curtailment.

May I now ask our experts the following questions:

(*a*) How does the "personality" training of men who are not capable to fill a job affect others who are not similarly trained but who are more capable to fill that job. In other words, here are two men. One of them has been trained in personality. He can make a good impression, but he has no qualifications to undertake a certain job. He has made a good impression and gets that job. The other man has not had training in personality. He does not make a good impression, and although he *can* fill the job, he fails to get it. Is this fair either to the employer or the employee?

(*b*) How does this training affect the employer himself? In other words, a man who has been trained in personality makes a good impression and gets hired. In time he proves to be a failure. After several such cases the employer gets wise and decides that these fellows from college have been trained to be slick and I am not going to trust them any more. In other words, the personality training is bound in time to be a self-destroying element.

(*c*) If all the men are "personality trained" how does the training help them to get jobs when there are no jobs to be had anyway?

(*d*) If the inability of our graduates to obtain employment is due to lack of personality training, then how is it that men who had already been employed were and are actually out of work during this depression with their positions entirely eliminated? Certainly the experts would not have us believe that the causes of such employment upheaval could be laid to the pressure or absence of personality training!

Will the experts be kind enough to answer these questions?

Now it must not be assumed from my discussion that I undervalue the importance that personality plays in life nor do I utterly condemn a course in "personality." My idea is this! We human beings are born with certain inherent traits which make each of us different from our fellow mortals. Certain traits might well be fostered, others should be subdued. Our best teacher is life, our best training lies in observation, our best guides are our intellect and our instinct and our best knowledge is knowing ourselves. These are the facts that we must impress upon the young who are entrusted to our care in universities. To my mind, the best means of impressing these facts is through personal contact, through hints, remarks, or suggestions and not through a "course in personality"

telling a person how to stand up or sit down or talk or walk or breathe or eat or . . .

I want to say one thing about Dean Freund's suggestion. I would like to see more of our men go into businesses of their own than try to get employment. This whole country was built by pioneers and it was built by adventurers. I would like to see that pioneering spirit survive.

Mr. Board: In the first place, I would like to say that the training that we have in mind is designed to bring out not what a man cannot do but what he can do, and so to make these men who may be less capable more useful, because they are headed in the direction in which they can be of use and where they can be successful.

Now, I refuse to admit that any man who can go through an engineering school is not useful in some place or other, and that if he is useful in some place, part of the effort needs to be directed toward discovering where that place is.

In the second place, I think that sending men out who are trained in the art, if it can be called that, of finding work for themselves—and I am not saying jobs—finding work for themselves, does tend to bring to the men, who have not thought about that and who may be out, the necessity of themselves preparing to get work in that way; and I spend a great deal of my time with older men trying to get them to see the thing that we are teaching, endeavoring to teach the undergraduates the technique of presenting their abilities so that they can get the jobs instead of those that are less equipped; and I do not see any reason why we should not continue this process through life. I think that the engineering societies have that in mind in the development of professional training.

The second question is, How does the training affect employers? I have talked with a good many employers, some of them about this. I think if when a man can come to an employer and present not the thing that he may like to do but not be able to do, but the capacities that he has, that the employer does not only save time but he is better satisfied in the end, and if the man cannot hold the job we do not want him there. We do not want to try and teach these men to get jobs they cannot fill.

Many of these boys have exalted and exaggerated ideas as to what they can do. They hear about these successful engineers, they read success stories in the magazines; we have these famous speakers come in who have made careers for themselves, and they think, well, perhaps I can do that myself. A lot of them cannot, and there is no use saying that they can. But if they can be led to see their own capacities, to plan a life which is based on real-

ity, even if it is a moderate progress, they may find satisfactions and they may find opportunities and benefits of living which we would not get otherwise; and I have no desire to try and shove men into jobs for which they are not fitted or where they cannot advance; and while I have not the complete figures on my work of the last few years, I would like to say in the first 200 men that I placed in jobs I placed them with 176 different companies, and practically none of them was a big one. That is the policy that I pursued personally in trying to do this type of work.

The third thing is that if all the men know how to do this thing, how are there going to be enough jobs to get around?

Professor Malti: The question I would like to ask is this: If all the men are trained, how does the training help them to get jobs when there are no jobs to be had? Now, that is the question.

Mr Board: Well, I will admit it was not brought out in the discussion. I think that the only solution in a great many instances is to teach these boys how they can go out and find opportunities in small communities.

It was President Morgan of Antioch and the Tennessee Valley Authority who a year ago in a convention which I attended gave the illustration of two young fellows in Indianapolis, I think, who found themselves out of work and with no jobs available. They looked around for something they could do—they were in homes themselves—and they decided that the people that were most overworked and most in need of help were the housewives and especially the mothers. So they started out and built up a business providing diapers every morning in quantities for the mothers of the community; and they made a success of it. Now, that is real service.

E. D. WALKER, Pennsylvania State College

I know Professor Moore is aggressive, but I understood him to say that he advised their graduates in these times not to try to hunt jobs because the jobs were not there. I really cannot conceive of Professor Moore intending to convey the impression that these young men should go home and fold their hands and sit down and wait for something to happen. I do not believe he meant that, although it sounded that way to me.

It has been implied a number of times that there are no jobs. I cannot agree with that. There are not as many jobs as there were, but there are jobs, and it is possible for the man who goes after the jobs to find the few that there are.

Professor Moore mentioned the matter of writing letters, implying that it was a waste of time, money, and energy. I do not believe it, and I am basing my opinion on the experience of some

of our own graduates in civil engineering at Penn State during these times of depression. One of the boys who graduated, I think in '31, told me that he went home and wrote about 200 letters, and most of them either brought no reply or the stereotyped reply, "We have received your letter, placed it on file for possible future reference," and so forth. Along about the end of the series of 200 letters that boy obtained three chances for work, and he took one of the three jobs that came to him as a result of these letters.

Well, I submit that the outlay of $6 for postage stamps, a little more money for letter paper and envelopes, is a very small expenditure for landing a job. I am not counting his time, because he had no work. If he had not been writing these letters he would have been at home, loafing around the corner store in his home town, or something of that kind, certainly not engaged in profitable work.

Another thing, as was pointed out by the last speaker, in telling our students how to go after jobs we are not trying to tell the man to sell himself to a job that he is not competent to fill, at least, I do not think any of us are. I tell my boys "Analyze yourself. There are some one or two or three things that you can do better than other things, for which you have received some preliminary training. Find out what the thing is that you can do best at present, that you really, honestly feel you are best fitted to perform; then your second best; and perhaps your third best. Look around over the field."

The city boy, of course, has an advantage over the country boy in this respect, because there are more places near his home where he may market his services. For the country boy I say, "Take the *Engineering News-Record* or some similar paper, and look over the list of contracts that are being advertised, and contracts that have been awarded. If you see a job that is going to be let or that has been let to a contractor, if you want to get in on the business side of engineering, write the contractor, tell him what you can do, and ask him if in extending his organization on account of this new contract he does not need a man who can be of some assistance in that particular line of work." Some of the boys have got jobs that way. Some have seen that the city engineer of some city is advertising a contract, it may be for sewers, street pavement, or something else, and they write, "Do you, in connection with this new work that is going to be undertaken in your city, need a man as inspector, assistant inspector," or something of that kind? I tell the boy not to rate himself too high.

I do not mean to imply for a moment that 100 per cent of our civil engineering graduates of the last three or four years have found jobs, far from it; I wish they had, but a number of them,

who in all probability would not have had jobs, have found them through that sort of procedure. They did not go home and fold their hands, waiting for somebody to come around at the door and hand them a job on a platter. They made attempts.

A. B. DOMONOSKE, Stanford University

In the first place, I am no expert. I have never liked the term "expert" since I heard a lawyer say, "First, liars, then darned liars, and then experts."

I wish to submit a formula to you which is due to Mr. Newton D. Cook, and I will have to modify it somewhat. It is the result of an experience in trying to get jobs for men on the Pacific Coast, when there were no jobs. He has defined it as follows: C is equal to A times I divided by D $\left(C = \frac{A \times I}{D}\right)$, where C represents the chances of securing work, A represents work available to the capacity of the applicant, I is the interest the employer takes in the applicant, and D is the distance.

In other words, if either of the numerator figures is zero, your chances of getting a job are zero. If your distance is infinite, the chances are probably zero. If D is zero, the formula may break down, because many a man has been right there and lost the job.

The inferences that you can draw from that formula are that if A is pretty small you had better find some way of increasing I. If you are unlucky enough to be affected by the distance term you must write a very much better letter than you might make application in the form of an interview.

It also brings in that consideration of the centralized versus the decentralized employment bureau of the university. The more red tape you put between an employer and the student, the greater will be that factor D. We have both methods at Stanford, and the central organization is broken up in two parts, one of which gets jobs for students registered at the University; the second one tries to get jobs for the graduates. The second one works with the Employment Committee of the School of Engineering, so that finally the contact is directly through the departmental member of the committee of the School of Engineering.

THE STRUCTURE OF THE ENGINEERING PROFESSION

By THEODORE J. HOOVER

Dean, School of Engineering, Stanford University

The development of many new fields of engineering endeavor in recent years, and the rapid growth of the tendency for engineers to specialize in certain fields, have made increasingly acute a problem which calls for scrutiny—the problem of classifying, for practical purposes, these various branches of engineering, and of designating properly or entitling the engineers who devote themselves to the projects lying within the various limited fields. This problem, of especial concern to educators, is of no little importance also to those dealing with state licensing and registration of engineers, to officers of national societies whose memberships have widely varying professional fields of interest, and to every active engineer who has ever attempted to analyse the segment he occupies in his profession and to define his relationships to engineers in other branches of its structure.

This is not a matter of mere academic interest, but of high practical concern. To the educator, some scheme of classification is essential before any attempt can be made to discuss the proper guidance of students in the choice of a field of practice, to set up curricula that will best serve the needs of the student looking toward practice in a particular field, or to define the meanings of various engineering degrees.*

Few modern educators would disagree on the qualifications that any man who calls himself an engineer should possess. There is only little less agreement concerning the proper qualifications for the man who calls himself a civil, mechanical, electrical, chemical, or mining engineer, for these designations are traditional and each has served for many years to denote a group of engineers who have had, on the whole, many interests in common. But this old and broad division into five main branches is far from being a clear and separate system of growth. Each branch has many offshoots; offshoots from several branches intertwine; there are a few rank growths that would be better for the pruning knife; there is not a little deadwood about; and there is considerable obtrusion of alien branches stemming from separate bodies of knowledge

* Forty-two different degrees in engineering are at present offered by the schools and colleges in the state of New York.

and skill. Then, too, such an analogy does not take into account the series of common activities which take place within the bounds of every engineering zone of interest—the *functional* activities such as research, design, construction, operation, and the like, which have recently come to be recognized as offering an equally useful, or even perhaps a more useful, basis for vocational classification for guidance purposes.

Other schemes of classification, such as those based on rank or on capacity of the engineer, might also be applied to the subdividing of the profession. That no single scheme has gained any wide acceptance by the members of the engineering fraternity is demonstrated by the exotic and undefined collection of titles which may be found in any engineering directory. Anyone seeking to satisfy the curiosity of youth in regard to this bewildering display of nomenclature—to answer, for example, such a question as: "What is an acoustical engineer, and what should he be able to do?"—cannot but be impelled to make a more careful analysis of the structure of the profession, and even to venture to propose a program by which a more consistent and useful scheme might be devised and generally adopted. It was this motive that impelled the present writer to carry out a series of statistical studies, to be reported here and elsewhere, designed to display a cross-section of the engineering profession at the present time, the results of which might serve as a basis for recommendations aimed toward the establishment of a more consistent and definitive scheme for the classification of engineers.

None of the statements in this paper, it must be understood, should be interpreted as advocating early specialization by engineering students. Specialists in one or another zone of engineering effort are made, not born; and it seems to be generally true that an engineer becomes a specialist through a chance interest or because he was thrown in contact, early in his career, with problems in a particular sector of the field. There is no method known to me by which an educator may examine an engineering freshman and predict that he will be more successful as a mechanical engineer than as a civil engineer. For this reason, the Stanford School of Engineering, in agreement with the best modern educational theory, has always aimed primarily to give all undergraduates a broad and basic training in the fundamentals common to all branches of engineering, with a minimum of special technological electives, leaving such "practical" knowledge to be gained in graduate years or in practice.

None the less, specialization of field and function is a marked characteristic of the present age, going far beyond the old rough separation into civil, mechanical, and the rest of the major fields.

For instance, of the 15,000 members of the American Society of Civil Engineers in 1931, a count shows that only 360 of these men, or a little more than two per cent, gave as their title merely "civil engineer." Many special branches of engineering, indicating a greater division of labor in this growing profession, have existed for some time, some of which are represented by other national societies, and some of which have been given legal standing. Each major society maintains a number of technical committees indicative of active interest by members in certain specialties; but these committees reveal no logical plan of subdivisions of activities.

Even under the broadest definitions of the traditional major divisions, it is impossible to cram these specialties under one or another head. Is, for example, a metallurgical engineer to be classified under chemical or under mining engineering, or is his specialty to be made a major heading? Under which of the five headings should be placed an explosives engineer, an engineer designing ship hulls, a ceramics engineer, an air-conditioning engineer, a transportation engineer, an industrial engineer, a gas engineer? These are only a few of the difficulties one encounters when trying to sketch a picture of the subdivisions of the profession today. Unless these titles are defined and are used with some greater unanimity than now exists, they are, as descriptive terms, virtually meaningless. Yet anyone wishing to make a quantitative fact analysis of the existing branches of engineering can approach the question only by using as his data the titles by which engineers designate their special fields. Such a preliminary analysis, based on the titles to be found in *Who's Who in Engineering,* will now be reported, in the belief that it will be of no little interest to all engineers.

A Study of Engineering Titles

An analysis of titles used by engineers, although it appears to be the best method of attempting to show a cross-section of the profession, brings up several difficulties not easy to resolve. In the first place, confusion exists between a man's *professional title* and the designation of his current *position;* and in most engineering directories these two are used indiscriminately. A man may, for example, have devoted his career to "highway engineering," and for our present purpose we are not primarily concerned with the fact that he is at present "assistant city engineer and superintendent of streets." The designation of his rank and place in some organization is usually a matter over which the engineer has no control. Naturally, no one (unless it be a member of a state licensing board) can question an engineer's right to assume, in his professional title, any modifying term that he

likes; but it should be pointed out that the majority of these professional titles are not chosen primarily to be *descriptive*, and it is apparent in some cases that vanity or even less agreeable motives have been responsible for the choice. Again, many engineers bear titles unique to them alone among all the thousands of their fellows, and it is certain that a title descriptive of the activities of a single individual is of no great value for classification purposes. In contrast to these too-specialized titles is the frequent practice of putting down the unmodified title of "engineer"; the title may be exact if the possessor is competent to practice in almost any segment of the range of engineering activity, but is of no value in building up a quantitative picture of the divisions of the field as a whole.

In spite of these difficulties, it was thought that the first step in attempting to make a fact analysis of the structure of the profession should be to make an alphabetical list of titles given by all the engineers whose biographies are given in the latest edition of *Who's Who in Engineering* (1931). These titles, which appear immediately following the name of the engineer, were given in response to the heading "Profession or Occupation" appearing in the blank filled out by each man. It is true, of course, that this group of men does not give an accurate cross-section of the whole profession, but only of those who, in the opinion of a group of qualified judges,* are considered to have attained professional eminence. The list of titles is somewhat heavily loaded in favor of authors and educators, and moreover, titles common in the lower ranks of the profession, and among the younger members, are not truly represented in the list. However, it was believed that the list would be valuable for the purpose of discovering the most frequent titles from the point of view of *specialization*, since specialists are more likely to be found among the older and more eminent men of the profession. As a basis for a preliminary study, *Who's Who in Engineering* offered a number of advantages over the several annual directories of the various national engineering societies: the total group is much smaller; the requirements for inclusion in the *Who's Who* book may be rather clearly stated, whereas the requirements for membership in the various societies are diverse and selective in different ways; and all the titles to be found in the book were given in response to the same question. As a matter of fact, however, it was later found that, although the results from the *Who's Who* study were highly im-

* An Advisory Committee of the American Engineering Council, consisting of 13 members, assisted the editor of *Who's Who in Engineering* in selecting the names of those men who, according to certain stated professional and technical qualifications, should be included in the book.

portant in obtaining a rough picture of the professional groupings, a number of fairly common titles were not given. For this reason a series of later studies, using the same methods of analysis, were made of the titles of all the members listed in the respective 1931 directories of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Institute of Chemical Engineers. It is hoped that the results of these studies may be soon made available to those interested in the structure of any of the main traditional branches of engineering represented by these national societies.

An alphabetical frequency list of every possible variation in the titles of the 10,542 men represented in *Who's Who in Engineering* showed a total of 2,518 different titles (without any attempt at grouping and considering, for example, the title "mechanical and electrical engineer" to be distinct from "electrical and mechanical engineer"). Of these men, 18 gave no title, 371 gave simply "engineer," and 13 "engineering." The length of the titles given varied from one word to 14 words. There were 1,838 *unique* titles in the group, or 73 per cent. A number of the titles might be considered synonymous (e.g., "teacher," "instructor," and "educator") or are found in slightly differing or inverted forms (e.g., "civil, consulting engineer," "civil consulting engineer," and "consulting civil engineer"); but any attempt to condense the list by throwing together arbitrarily even these fairly simple variations leads to impossible confusion.

Numerical Frequency List

A first attempt was made to reduce this list on the basis of numerical frequency. The fifty most frequent titles in the list, all of which appeared more than 20 times, are as follows:

civil engineer	1,540	manufacturer	63
electrical engineer	868	research engineer	63
mechanical engineer	784	telephone engineer	61
consulting engineer	504	professor	58
mining engineer	410	consulting mining engineer	51
engineer	371	mechanical and electrical engineer	49
chemical engineer	243	sales engineer	47
teacher	180	sanitary engineer	44
geologist	136	electrical and mechanical engineer	41
executive	124	agricultural engineer	39
structural engineer	86	construction engineer	37
metallurgical engineer	83	educator	37
metallurgist	77	hydraulic engineer	37
industrial engineer	69		
consulting civil engineer	68		

civil and mining engineer	35	consulting chemical engineer	25
chief engineer	33	mining engineer and geologist	25
chemist	31	mining geologist	25
highway engineer	31	radio engineer	23
petroleum engineer	30	civil and mechanical engineer	22
president	30	manager	22
architect	29	ceramic engineer	21
mining and metallurgical engineer	28	consulting mechanical engineer	21
physicist	27	editor	21
executive, engineer	26	petroleum geologist	21
vice-president	26	professor of electrical engineering	21

This list based on a count of the commonest titles used by the men in the group, although it takes care of 6,743 names, or 64 per cent, is still far from revealing very much in regard to many of the important branches of the profession. In the first place, although it is assumed that all the men listed in *Who's Who in Engineering* are in reality engineers, it appears that many of them do not consider themselves as engineers primarily, but rather as teachers, executives, manufacturers, chemists, physicists, architects, editors, and representatives of a dozen other sciences, professions, and businesses which are more or less remotely connected with the fundamental job of the practicing engineer. Moreover, it is apparent from the above list that, even if only those who specifically designate themselves as engineers are considered, they may classify themselves from several different points of view. For example, it is clear that words like "sales" and "research" are of a different sort from words like "highway" and "telephone," and that words like "chief" or "consulting" are of sorts different from any of the rest.

List of Adjectives Modifying "Engineer"

Accordingly, a second attempt was made to achieve some sort of order by selecting from the alphabetical list all the adjectival terms anywhere to be found modifying the word "engineer," thus boldly ruling out all the men who did not classify themselves primarily as engineers. These modifying adjectives, which indicate a total of 337 special branches of engineering represented by the men studied, were then sorted into nine groups of different categories as follows:

1. "Engineer" or "general engineer."

2. Words designating GENERAL FIELD. These comprise the major traditional engineering fields, as follows:

chemical (engineer)	metallurgical
civil	military
electrical	mining
mechanical	

3. Words designating ZONE OF INTEREST. Such words indicate the specific *structures, materials,* or *products* to which the specialist devotes himself, or the *special technology* which he uses in his particular work; and the list as a whole furnishes a good general description of the varied types of problems which may be encountered in the domain of engineering:

acoustical (engineer)
aerial mapping
aerial tramway
aero
aeronautical
agricultural
air-conditioning
aircraft
aircraft radio
airplane
air transport
airway mapping
architectural
automobile
automotive
automotive transportation
aviation
aviation lighting
boiler
bridge
broadcast
building
building equipment
cadastral
cement and concrete
ceramic
city
coal beneficiation
coal concentration
coal-mine
coal mining
coal processing
coke
coke-oven
color and illumination
combustion
communication
community
concrete
conveyor
conveying equipment
dairy
docks
drainage
dredge mining
drying
electric railway
electric traction
electric utility
electrochemical
electro-metallurgical
excavating
explosives
factory
filtration
fire insurance
fire prevention
fire protection
fire resistance
flood control
flotation
forest
forest products
foundry
fuel
furnace
garage
gas
gas and gasoline
gasoline plant
geodetic
geologic
geological
geophysical
glass
handling
harbor
heat
heating
high-tension
highway
housing
hydraulic
hydro-electrical
hydro-metallurgical
hydrographic
hydro-pneumatic
ice-plant
illumination
industrial
industrial building
insulation
insurance
iron and steel
irrigation
lamp
landscape
light
lighthouse
logging
lubricating
lubrication
lumbering
machine tool
magnetic
magnetic measurements
marine
material handling
materials
metal mining
mill
mine
motion picture
motor
moulded plastics
municipal
natural gas
naval
naval architectural
oil
oil and gas
ordnance
ore-dressing
oxyacetylene
paint
paper mill
patent
paving
petroleum
petroleum refining
pier
placer mining
plant
power
power plant
power station
power transmission
public health
public service
public utility

pulp and paper mill
pulverized fuel
pumping
purification
quarry
radio
radio telephone
radio transmitter
railroad
railroading
railway
railway electrification
railway signal
real estate
reclamation
refractories
refrigerating
refrigeration
reinforced concrete
river improvement
road
road and sewer
rubber
sanitary
sewage disposal
sewer
shipbuilding
signals
sound recording
sound studios
steam
steel
steel plant
street lighting
street railway
structural
submarine cable
sugar
switchboard
telegraph
telephone
temperature
textile
thermal
thermodynamics
tidal
timber
timber preservation
topographic
topographical
track elevation
tractor
traffic
traffic signal
transmitting
transmission
transmission and protection
transmission line
transportation
triangulation
underground
utility
ventilation
water
water purification
water rectification
water softening
water supply
waterworks
welding
wood burning
wood preservation
wood technology
wood treating
woodworking
works
X-ray

4. Words designating ENGINEERING FUNCTIONS. The word "function" is herein used in its common meaning as "any special kind of action, activity, office, or service properly belonging to a person or thing." The engineering process, carried on from the time a particular human need is recognized until the time when that need is satisfied through organized engineering effort, may be divided into a number of steps, each one of which calls for the exercise of a certain function. For example, suppose that a need is felt to supply a given human want by means of a product which can be produced under the direction of engineers. The whole process will include the following steps, which illustrate the main functions properly belonging to the engineer today: (1) *Research* on the problem of satisfying the need, (2) *Invention* or adaptation of existing means and methods to perform the task efficiently, (3) Preliminary *valuation* of project, (4) *Financial planning* of project, (5) *Organization* of effort for coöperation, (6) *Promotion* of project, (7) *Design* of project, (8) Design and *construction* of plant and equipment, (9) *Supervision* of *operation* and *production,* which includes (*a*) *Maintenance* of plant, (*b*) *Testing* of product, (*c*) *Inspection* of plant, and (*d*) *Safety work;* and, finally, (10) *Sale* and *distribution* of product. *Management* may be considered from this point of view as being the art and science of directing and coördinating efficiently all these functions.

Now, it matters little in this case whether the engineering product be a bridge or a telephone or an automobile: the functions of research, invention, design, production, sale, and the rest are all required, and each function is performed according to the same principles wherever found. That is to say, a good bridge designer must not only know something about bridges, but he must also know the principles of design; a good sales engineer must know his product, and must also know how to sell. During such a project, a single engineer may perform one function, or several, or even, conceivably, all of them.

The history of engineering in the past century has shown not only a great increase in specialization of *field* and *zone of interest*, but likewise an increase in specialization of *function*. The engineer has been called upon not only to utilize new sources of power, new materials, and new chemical and mechanical discoveries, inventions, and techniques, but he has also been called upon to enlarge his functional range—to add to his former duties of designing engineering works, directing their construction, and superintending their operation, new duties which require that he apply his talents to such fields as organized research, financial planning, promotion of enterprises, scientific management, and selling. This gradual widening of the province of the engineer has frequently led to confusion of terminology, so that it is only now beginning to be realized that there is a difference of kind between the special technology used in a branch of engineering, and the point in the process at which this technology is functionally applied.

Once this distinction is broadly recognized and analysed, it will be found highly useful in differentiating engineers in a practical way. For example, for the purposes of educational and vocational guidance, may it not be more important to attempt to classify an engineering student functionally rather than by his particular zone of interest? In other words, may it not be that innate individual differences in capacity to become an able inventor, designer, administrator, salesman, organizer, or teacher are greater, and more easily discoverable, than are individual differences in interests that might lead a man to devote his efforts successfully to a particular field, such as automobiles, power lines, bridges, dams, mines, machine tools, or the like? If a man is a born manager, is it possible or useful to discover early in his career whether he will be most successful as manager of a mine, or manager of a construction company? The answers to such questions, although highly interesting, cannot be sought with much hope of success until this difference of kind has been studied, defined, and widely recognized by the profession.

The functional adjectives used to modify "engineer" are much

fewer than those describing zones of interest, and are not quite as self-explanatory as these latter designations. Words like "research," "valuation," and "organization," although often used, seldom mean quite the same thing to different persons, and their meanings in engineering titles should be precisely defined and stated. The word "development," for instance, has come to mean, to electrical engineers, the process of taking the results of research and adapting and applying them for industrial manufacture or use. To the mining engineer, on the other hand, "development" refers to the exploration of a mineral deposit by drilling or driving openings into the vein. Space does not here permit any attempt to give definitions for the various engineering functions listed below, but it is safe to say that engineers too frequently use them without any clear understanding of their meanings. The designations which seemed to the writer to be clearly functional are as follows:

administrative (engineer)	efficiency	organizing
application	erection	organization
assembling	examining	personnel
business	executive	planning
commercial	experimental	production
conservation	fabricating	promotional
constructing	financial	research
construction	inspecting	safety
contracting	inspection	sales
contraction	investment	sales promotion
cost	maintenance	statistical
design	management	supervising
designing	managing	test
development	manufacturing	testing
distribution	operating	valuation

5. Combination of words designating (*a*) FIELD AND FUNCTION or (*b*) ZONE OF INTEREST AND FUNCTION. From the point of view of descriptiveness, this combination is excellent. It gives a clear picture not only of the zone of interest of the specialist, but also the particular function he performs. Although not a great many titles of this sort were found in the list, it should be pointed out that appropriate titles like these may easily be made by combining almost any adjective under List 2 or List 3 above with almost any adjective under List 4. The combined titles found were:

building construction (engineer)	industrial efficiency
city planning	industrial research
electric testing	illumination recommendation
electronic research	irrigation investigations
gas distribution	land valuation
geological production	machine design
geophysical research	petroleum production

petroleum research
physical research
power plant design
power sales
radio research
railroad construction
railroad maintenance
scientific research
steel construction
system valuation
telephone systems development
water conservation

6. Words denoting CAPACITY in which the engineer utilizes his knowledge and skill:

advisory (engineer)
army
consulting
educational

7. Words denoting RANK. These words indicate present position held by the engineer, but are of little value in classifying the branches of engineering:

acting (engineer)
assistant
associate
chief
senior

8. Words describing GEOGRAPHICAL LOCATION of the engineer. These also are of little value for classification purposes. It is likely that in reality, most of them are indications of position held by the engineer rather than his special professional field:

borough (engineer)
corps area
county
district
division
international
resident

9. Words describing PROFESSIONAL STATUS. Such words are least useful of any of the above sorts for the purpose in view:

certified (engineer)
graduate
licensed
practicing
professional
registered
retired

It might be taken for granted that *all* the engineers in the group studied are "graduate" (or its equivalent) and "professional," and that if required by law they could become "registered," "certified," or "licensed." It is suspected that those few men who used these terms are especially concerned in spreading the laudable doctrine that engineering is a vocation requiring professional train-

ing. The word "retired" might, of course, properly be given after the title of any engineer no longer in practice.

A few titles were found which did not clearly fit into any one of the nine categories above. Several of these strike one as being merely weird inventions which are meaningless and unnecessary, such as "bank management engineer," "college engineer," "export engineer," "extension and agricultural engineer," "mechanical gas and gasoline engineer," "social engineer," and "technical publicity engineer." Others, such as "city civil engineer," "county highway engineer," "division plant engineer," "special design engineer," and "special tube engineer," are probably indicative of official position rather than field or function; these men are probably "municipal engineer," "highway engineer," "plant engineer," "design engineer," and "tube engineer." "Railroad civil engineer" seems redundant; a better term might be "railroad construction engineer." "Training engineer" conveys little meaning, although one might guess that the engineer is engaged in personnel work. "Managing sales engineer" is, at a guess, a sales manager who happens to be an engineer. The only remaining titles are "field engineer" and "office engineer." These two terms might have been included under the geographical location list, but they are so often used in apparent contradistinction that they might seem to be a separate way of classifying all engineers. Actually, the only hint these terms give of the work the engineer does is to suggest that he spends more or less of his time away from the headquarters of an organization. It is felt that these two terms are of very little value as part of an engineer's professional title.

Significant Words in Engineering Titles

The study of adjectives used to modify "engineer" given above could not, for many reasons, yield to numerical treatment. A plan was devised which it was hoped would combine a numerical frequency listing with a word study such as that just described. Accordingly, the laborious task was performed of making an alphabetical frequency list of all "significant" words (omitting "and," "of," "in," etc.) found in the titles given by all the men represented in *Who's Who in Engineering.* Certain variant words from a single root were listed together, *e.g., geolog*(*ic*) (*ical*) (*ist*) (*y*), or *special,* (*ist*) (*ization*) (*izing*) (*ties*) (*ty*), since all variants were taken as representing virtually the same idea.

A total vocabulary of 563 significant words (plus their variants) was found in the titles given. These words appeared 23,893 times, making two significant words the average number for each title. These significant words were then classified according to groups of

categories similar to those used in the study of adjectives modifying "engineer," as defined above. Only a summary of this revealing word list can here be given.

Category	No. Significant Words + Variants	No. Times Such Words Appeared	Per Cent of Total Times
1. The words "ENGINEER" or "ENGINEERING"	2	8,902	37
2. Words designating GENERAL FIELD (civil, mechanical, etc.)	7	6,158	26
3. Words designating ZONE OF INTEREST (acid, acoustical, aerial, etc.)	246	2,454	10
4. Words designating ENGINEERING FUNCTIONS (application, appraisal, assembling, etc.)	53	2,042	09
5. Words designating CAPACITY (army, college, consultant, etc.)	21	2,706	11
6. Words designating RANK (acting, assistant, associate, board, etc.)	41	500	02
7. Words designating GEOGRAPHICAL LOCATION (area, borough, branch, etc.)	21	140	006
8. Words designating PROFESSIONAL STATUS (commissioned, emeritus, graduate, etc.)	8	105	004
9. Words designating occupations NOT PRIMARILY ENGINEERING (accountant, advertising, agent, attorney, etc.)	63	462	02
10. MISCELLANEOUS words (mainly auxiliary, or not clearly belonging to a previous group)	101	424	02
	563	23,893	100

Since four types of descriptive words—the types here termed as *general field, zone of interest, function,* and *capacity*—are apparently used preponderantly in the engineering titles studied, it seems clear that all these types should be included in any scheme proposed for classification of engineers. The remaining types of words—those here termed *rank, geographical location, professional status,* and *not primarily engineering*—although they may be needed to indicate a man's present position in an organization, are not greatly used at present, and might well be left out of consideration in planning a standard system of classification of engineers by professional title.

RECOMMENDATIONS

The rapid increase in specialization among engineers has brought an urgent necessity to attempt to establish some standard scheme by which the recognized branches of the profession, and the titles

of engineers devoting themselves to special branches, might be designated. It is believed that any such attempt to bring order out of the chaos now existing in this situation would be of great value to all engineering educators; to national engineering societies whose memberships display a wide variation in special fields of interest; to those concerned with the licensing of engineers; and to all active engineers who themselves desire to understand the place they occupy in the structure of their profession, and who hope to inform the general public as to the position they occupy in our complicated social structure.

For this reason, it is suggested that the main national engineering societies set up an inter-society joint committee to make a study of the structure of the engineering profession and, if possible, to decide upon a standard scheme by which engineers in the various branches of the profession might designate themselves. It would then not be difficult for each society to recommend to its membership the use of this uniform method of classification at all times. As initial topics for discussion by such a committee, the following proposals, growing out of the series of studies which have been carried on by the present writer, are suggested:

1. That all men who are primarily engaged in work of an engineering nature—as distinguished from pure scientists on the one hand, and non-professional technicians on the other—should use the word "engineer" as a part of their professional titles. Titles such as "chemist," "metallurgist," and "geologist," or "builder," "designer," and "salesman," should become "chemical engineer," "metallurgical engineer," "design engineer," "sales engineer," etc., if the work done is fundamentally concerned with the professional applications of engineering science to industry.

2. That all engineers be asked to make a distinction between *professional title* (indicating the branch of engineering to which their careers have been devoted) and *present position* (indicating the place and rank they occupy in an organization). This could be easily done by allowing two lines instead of one in the information blank from which annual directories are prepared: at present, these two kinds of titles are used indiscriminately. The best means of achieving uniformity in stating professional title would perhaps be to print on the blanks two lists of adjectives—one giving field and zone of interest words and the other giving functional words—and to ask the engineer to select and write in his particular designation. (See suggested model form for American Institute of Mining and Metallurgical Engineers members below.)

3. That all professional titles be composed of two types of adjectives—first, adjectives indicating special *field* or *zone of interest*, and second, adjectives indicating special *function* performed.

These combination titles would be of such a sort as "electrical research engineer" or "bridge design engineer." Compound adjectives could, of course, be used, as in "railway-bridge design engineer." In certain cases, words indicating special *capacity* might need to be prefixed (*e.g.*, "*consulting* electrical research engineer," "*professor* and bridge design engineer").

4. That in choosing an appropriate professional title, the engineer might best describe his activities by using one of the four following combinations:

(*a*) If the engineer is competent to practice in all branches of engineering, he should designate himself as "general engineer."

(*b*) If the engineer considers himself to be a specialist in all functions in a particular *field* or *zone of interest*, he should designate himself as "general civil engineer," "general electrical engineer," etc., or as "general acoustical engineer," "general bridge engineer," etc.

(*c*) If the engineer considers himself to be a specialist in all fields or zones of interest in a particular *function*, he should designate himself as "general design engineer," "general research engineer," etc.

(*d*) If the engineer considers himself to be a specialist in a certain *field* or *zone of interest*, and likewise in a certain *function* in that field, he should designate himself by a combination of these two types of title, as "electrical research engineer," "bridge design engineer," "building construction engineer," etc.

Using only the words to be found in the lists of adjectives previously given which designate field, zone of interest, and function—each of which adjectives may be rigidly defined in small space—it is possible according to this recommended scheme to make up more than ten thousand different combinations of titles which are highly descriptive and whose meanings may be at once clear. This plan of building titles from a number of interchangeable words would be flexible enough, it is believed, to permit a good classification of engineers indefinitely, since new words may be admitted to the lists when demanded to describe new functions and new zones of interest taken over by the profession.

The practical working of this plan of classification is exemplified in the model classification form here proposed for the American Institute of Mining and Metallurgical Engineers which appears below. Similar forms, with suitable changes, could be used by any of the major societies.

MODEL FORM FOR CLASSIFYING
MINING AND METALLURGICAL ENGINEERS

1. **Profession or occupation:** .....

NOTE: If you are an *engineer*, please give above your professional title, by prefixing to the word "engineer" one of the adjectives in either List A or List B below, or a combination of an adjective in List A and one in List B. For example:

Mining engineer (from List A)
Fuel engineer (from List A)
Research engineer (from List B)
Fuel research engineer (combined from List A and List B)

The word "consulting" may be added before any title. A double title may be given (*e.g.*, "Mining and mechanical engineer," "Design and construction engineer," "Iron and steel production engineer," "Professor and mining engineer").

LIST A (Fields and Zones of Interest)		LIST B (Engineering Functions)	
Assaying	Metallurgical	Administrative	Maintenance
Blast-furnace	Mill	Appraisal	Management
Ceramic	Mineral	Construction	Manufacturing
Chemical	Mine	Contracting	Operating
Civil	Mining	Cost	Personnel
Coal	Open-hearth	Designing	Production
Coal-mine	Ore	Development	Promotion
Concentration	Ore-dressing	Economy	Prospecting
Drilling	Petroleum	Efficiency	Research
Electrical	Plant	Examination	Safety
Electrochemical	Quarry	Experimental	Sales
Factory	Refinery	Exploration	Supervising
Flotation	Sampling	Financial	Testing
Fuel	Smelter	Inspection	Valuation
Gas	Steel	Investigation	Other function
Geological	Steel plant		
Geophysical	Structural		
Hydraulic	Surveying		
Industrial	Underground		
Iron	Ventilation		
Laboratory	Works		
Mechanical			
Metal	Other zone of		
Metal mine	interest		

2. **Present position and rank** (e.g., "Superintendent, Open Hearth Dept., ——— Steel Corp., Pittsburgh, Pa.," "Asst. Prof. of Metallurgy, ——— Univ."):

.....

5. That, since most of the words descriptive of engineering functions are not self-explanatory, a list of definitions be composed and agreed upon to delimit the indiscriminate use of adjectives describing the various proper functions of engineering.

6. That all abbreviations used for words appearing in professional titles given in the societies' directories and elsewhere be made uniform. This apparently trivial matter will not seem so trivial to anyone who has attempted to discover, by examining some curious jumble of letters, whether the engineer whose name they follow might be, for example, a consulting engineer, a construction engineer, a contracting engineer, or something different from any of these. It should be remarked that not one of the major engineering societies gives a key to the abbreviations used throughout its directory.

It is considered important for scientists to classify with great care the various species and sub-species of birds, insects, minerals, and plants; how much more important, then, should it be to give attention to the classification of the various species of the genus Engineer, whose members have had such a hand in the making of the modern world! The writer feels strongly that any attempts at this time to make the engineering fraternity more keenly aware of the almost meaningless and frequently confusing use of engineering titles at present prevailing cannot but lead to valuable results in greater understanding of the logical divisions of the profession, to clarification of the differences that distinguish one branch from another, and to better comprehension of the qualities requisite for success in each branch.

NECROLOGY

MILO SMITH KETCHUM, Dean Emeritus of the College of Engineering of the University of Illinois, died on December 19, 1934. He was born near Kenawee, Illinois, on June 26, 1872. He received the B.S. degree from the University of Illinois in 1895 and the professional C.E. degree in 1900. For two years after graduation, he served the University as instructor in civil engineering and mathematics, after which he became contracting and designing engineer for the Gillette-Herzog Manufacturing Company. He remained with this organization for two years, and during this time he designed and constructed many mining and mill buildings and head frames in the mining regions of the Northwest. In 1899, he returned to the University of Illinois as Assistant Professor of Civil Engineering and served in that capacity until 1903, when he resigned to become contracting manager of the American Bridge Company in charge of their Kansas City office. In September 1904, he went to the University of Colorado as Professor of Civil Engineering, and in 1905 became Dean of Engineering in that institution. From February 1918 to February 1919, while on leave from the University of Colorado, he was Assistant Director of the U. S. Government Explosives Plant in administrative charge of construction of the smokeless powder plant at Nitro, West Virginia. In 1919 he accepted the position as Professor of Civil Engineering and Director of the Department at the University of Pennsylvania. He remained with that institution until 1922, when he became Dean of the College of Engineering and Director of the Engineering Experiment Station at the University of Illinois. After serving in this capacity for a number of years, his health began to fail; and in 1933 he resigned this position to become Research Professor of Civil Engineering. In September 1934, he was made Dean Emeritus of the College of Engineering.

He was always very must interested in engineering education and gave much time and effort to its advancement. He served as Secretary of the Society for the Promotion of Engineering Education from 1904 to 1906 and as President during 1917–1918. He was deeply interested also, in the practical phases of the profession; and very early in his career became actively associated with the American Society of Civil Engineers. He served as Director of the Society for two years from 1918 to 1920 and as Vice-President during 1925–1926. In 1934, he was elected to Honorary Membership. He was a member, also, of numerous other engineering

and scientific societies. In 1926, the Colorado School of Mines conferred upon him the honorary degree of Doctor of Science and in 1927 the University of Colorado awarded the same recognition. In addition to his duties as teacher and administrator, Dean Ketchum found time to write many books on engineering subjects, mostly in the field of structural engineering, for the use both of students and practising engineers. The most widely used of these is his Structural Engineer's Hand-Book. During all of his years of service to the engineering profession, he was a leader of wide and wholesome influence; and he contributed much thereby to the training of teachers and students and to the general advancement of the profession. In his untimely passing, the University of Illinois, in particular, and the engineering profession, in general, have lost one of their most loyal and fervent friends.

NEW MEMBERS

BULLEN, CHARLES V., Professor and Head, Department of Electrical Engineering, Texas Technological College, Lubbock, Texas. J. C. Hardgrave, O. V. Adams.

BUSH-BROWN, HAROLD, Professor of Architectural Engineering, Georgia School of Technology, Atlanta, Ga. R. S. Sweigert, W. V. Dunkin.

CLAPP, M. ROGER, Instructor in Mechanical Engineering, Texas Technological College, Lubbock, Texas. J. C. Hardgrave, O. V. Adams.

FISHER, ROBERT A., Instructor in Chemical Engineering, University of Louisville, Louisville, Ky. B. M. Brigman, R. C. Ernst.

FLETCHER, WENDELL S., Instructor in Engineering, Fullerton District Junior College, Fullerton, Calif. J. W. Hazen, C. E. Guse.

FREUD, B. B., Professor of Organic Chemistry, Armour Institute of Technology, Chicago, Ill. J. B. Finnegan, H. F. Heald.

HATHAWAY, ARTHUR S., Assistant Professor of Surveying and Drawing, Northwestern University, Evanston, Ill. Wm. C. Bauer, W. M. Bauer.

HUTCHISON, ALBERT W., JR., Instructor in Civil Engineering, Vanderbilt University, Nashville, Tenn. F. J. Lewis, F. G. Slack.

KINNEY, EDWARD D., Associate Professor of Chemical Engineering, University of Kansas, Lawrence, Kans. (reinstatement). A. H. Sluss, D. C. Jackson.

KOPAS, JOSEPH S., Instructor in Electrical Engineering, Fenn College, Cleveland, Ohio. M. E. Nichols, W. C. Davis.

OSBORN, FRANCIS C., Head, Industrial Arts Department, Arizona State Teachers College, Flagstaff, Ariz. F. L. Bishop, Nell McKenry.

PARKS, RUSSELL B., Assistant Professor of English, Lewis Institute, Chicago, Ill. J. G. Bennett, B. D. Greenshields.

PROSSER, EDWARD T., Assistant Professor of Physics, Georgia School of Technology, Atlanta, Ga. R. B. Sweigert, W. V. Dunkin.

SAGEN, GEORGE O., Instructor in Physics, Bakersfield Junior College, Bakersfield, Calif. K. W. Rich, F. O. Rose.

SEEGRIST, WALTER H., Assistant Professor of Mechanical Engineering, Armour Institute of Technology, Chicago, Ill. J. B. Finnegan, R. V. Perry.

SQUIRE, WALTER, Lecturer on Music Humanities, Stevens Institute of Technology, Hoboken, N. J. A. J. Weston, F. D. Furman.

ST. CLAIR, OSCAR A., Professor and Head, Department of Industrial Engineering, Engineering Drawing, and Industrial Education, Texas Technological College, Lubbock, Texas. J. C. Hardgrave, O. V. Adams.

STAPLES, ARTHUR J., Instructor in Mechanical Engineering, Worcester Polytechnic Institute, Worcester, Mass. F. W. Roys, T. H. Morgan.

TABER, THERON S., Instructor in Civil Engineering, Bakersfield Junior College, Bakersfield, Calif. K. W. Rich, F. O. Rose.

WATSON, JOHN W., Professor of Inorganic Chemistry, Head, Department of Chemistry and Chemical Engineering, Virginia Polytechnic Institute, Blacksburg, Va. P. T. Norton, Jr., S. R. Pritchard.

WESSMAN, HAROLD E., Associate Professor of Mechanics and Structural Engineering, University of Iowa, Iowa City, Iowa. C. C. Williams, B. J. Lambert.

WINN, C. C., Dean, College of Engineering, Detroit Institute of Technology, Detroit, Mich. F. L. Bishop, Nell McKenry.

COLLEGE NOTES

University of Detroit.—Apparatus has recently been constructed for the wind tunnel of the aeronautical engineering department to measure yawing and rolling moments on aircraft models. As far as is known, this is one of the few installations of its kind in the United States. In general wind tunnel practice, measurements are made of the lift and drag forces and the pitch moments operating in a vertical plane, corresponding to conditions of normal flight. Other forces such as the rolling moment about a longitudinal axis and the yawing moment or tendency to turn about a vertical axis occur only in curvilinear flight (fight maneuvers) or in the presence of a strong crosswind. It is now possible to measure all these effects, although not simultaneously, and the apparatus has already been introduced in a student laboratory problem, as well as being available for commercial tests. In student work, for example, the effect of rudder control or side drift can be demonstrated.

The University of Detroit wind tunnel has a throat measuring 10 feet across and 7 feet deep, and the new apparatus is designed to handle large and heavy models up to 7 feet in span. In measuring yaw and roll moments, the usual drag and lift balances are dispensed with and all the weighing apparatus is placed on a large turntable so as to obtain any desired angle of yaw. The model itself is suspended by a gimble joint from a vertical member free to rotate about its own axis. This member is tubular with a large mid-section to resist bending moments and is mounted in deep-groove ball bearings top and bottom. Four diagonal struts brace the bottom bearing to the turntable above. By means of an index sector the model can be set and locked to various angles of "attack" or lift with relation to the air stream. The model is free to rotate about its own longitudinal axis, but is restrained at one wing tip by a weighted wire through which the rolling moment is measured.

Support of the turntable is by rollers bearing on the top and inside of an angle iron circular track. Friction holds the table at the desired angle of static yaw. From the wing tip the wire comes up to the pan stud of an ordinary Toledo scale, and to the top of the pan is bolted a steel arm carrying a piston operating in an oil dashpot. Readings are made by bringing the pointer to zero through manipulations of the rider weight on the balance arm,

and reading its position to quarter pounds. For obtaining the yaw moment, one of the horizontal balances has been taken from the measuring room and bolted to the turntable. The balance is actuated through an 18-inch lever arm off the tubular spindle supporting the model. This instrument is electrically operated and reads in pounds and hundredths directly. It also is stabilized by an improvised oil dashpot of the paddle type. Lift and drag forces are automatically eliminated in this set-up since the spindle is free only to rotate, but these forces are readily obtained with standard wind tunnel apparatus.

The entire apparatus was constructed in the shops of the University with some F.E.R.A. student assistance.

University of Illinois.—The University of Illinois has been signally honored by having two of its Engineering Faculty members receive medals from the American Society of Civil Engineers in two succeeding years. In January, 1934, at its annual convention in New York City, the Society awarded to Professor Hardy Cross of the Department of Civil Engineering, the Norman Medal in recognition of his paper entitled, "Analysis of Continuous Frames by Distributing Fixed-End Moments." The paper appeared in the 1932 Transactions of the Society's publications.

At the coming annual meeting in January, 1935, the Society will award to Professor Harald M. Westergaard of the Department of Theoretical and Applied Mechanics, the J. James R. Croes medal in recognition of his paper entitled, "Water Pressure on Dams During Earthquakes." The paper was published in the Transactions during 1933, and was prepared by Professor Westergaard in connection with his work as consulting engineer in the design of the Boulder-Dam project.

Professor Cross is co-author with Professor N. D. Morgan of the University of Illinois of two books: Statically Indeterminate Structures, and Continuous Frames of Reinforced Concrete. He is the author of The University of Illinois Engineering Experiment Station's Bulletin No. 203, Dependability of the Theory of Concrete Arches, and Bulletin No. 215, Column Analogy; Analysis of Elastic Arches and Frames by the General Formula for Flexure.

Professor Westergaard is author of the publication, "Anwendung der Statik auf die Ausgleichungsrechnung," and is joint author with Harold Malcolm and W. A. Slater of another publication entitled, "Moments and Stresses in Slabs." Both men have made many contributions to current periodicals.

Iowa State College.—Beginning in the fall of 1935, freshman engineering students will not select a major department until their third quarter, according to T. R. Agg, dean of engineering.

An orientation course will be given to all incoming freshmen. During the fall quarter, the student will become acquainted with the profession of engineering. In the winter quarter, he will get an insight to design, management, operation construction, teaching, and research. After studying the opportunities in the various fields of engineering, he will choose a major from one of nine departments.

The drawing courses will be alike in all departments and the dean of engineering will select and supervise the instructors, who will be chosen from the present staff.

"At present, many freshmen make premature, uninformed choices upon entering college, grow dissatisfied after some time, but are dissuaded from changing their courses," stated Dean Agg. "As a result, they lose the strong interest and motive that are necessary if they are to do their best work.

"Others are permitted to defer the choice too long and drift aimlessly in the meantime, with the result that scholastic mortality in this group is abnormally high.

"Counselors do not have sufficient time to give the help really needed by the many freshman wavering among the various possible choices, and neither do they dare to recommend certain curricula as against others in any given case. Divisional deans seem to be the only officials who can direct the guidance program so that the freshman will receive unbiased, authentic information."

University of Kansas.—Professor W. C. McNown takes the place as chairman of the Department of Civil Engineering made vacant by the death of H. A. Rice. G. W. Bradshaw and D. D. Haines have been promoted to Associate Professors of Civil Engineering. John N. Herndon has been appointed Assistant Instructor of Civil Engineering. Earnest Boyce, Director of the Water and Sewage Laboratory and Engineer of the State Board of Health, has been promoted to Professor of Civil Engineering. John A. King has been promoted to Professor of Mechanical Engineering. Ralph D. Baker, Instructor in Mechanical Engineering, has been granted leave of absence for graduate study at the California Institute of Technology. Cecil W. Armstrong, a graduate of the University of Oklahoma, takes the place of Mr. Baker as Instructor in Mechanical Engineering. Frank J. Amador, a graduate of the University of New Mexico, is part-time Instructor in Electrical Engineering and is doing graduate work.

Massachusetts Institute of Technology.—A meteorological expedition from the Institute is sending up balloons at the Lambert-St. Louis flying field in an effort to ferret out more secrets of the stratosphere. The first balloons were released in November 20 and

the remainder—thirty-three in all—were sent aloft at two-hour intervals.

Each balloon carried a tiny instrument for recording humidity, temperature and atmospheric pressure at the various air levels through the stratosphere. Each was inflated to ascend to an altitude of from 50,000 to 60,000 feet. At this height they were expected to burst, causing the instruments in their shock-proof bamboo frames to fall to earth.

Experiments are being conducted by Chris Harmantas, research assistant in the school's department of meteorology. Balloons are sent aloft in accordance with instructions based on weather observations at the school's laboratories at Cambridge, Mass., and telegraphed to St. Louis.

It is hoped to determine, among other things, whether violent changes occur in the stratosphere during periods of changing temperature and to determine the approximate levels at which the maximum cold occurs.

A similar expedition, of which Harmantas was a member, conducted tests from the flying field at St. Louis last winter.

For the first time since its construction the high voltage generator, invented by Professor Robert Van de Graaff, was demonstrated before a group of students, the members of the M. I. T. Physical Society, at one of its fall meetings.

The generator consists of two huge spheres connected by a vacuum tube. Each of the globes is fifteen feet in diameter and is mounted on top of Textolite columns six feet in diameter and twenty-three feet high. The trucks on which the columns are mounted weigh twelve tons each and they roll on tracks fourteen feet apart.

The spheres, which are the heart of the generator, are constructed of ¼ inch aluminum alloy and weigh 3,000 pounds each. The electric current is carried up to these spheres by means of a paper belt four feet wide which travels at the rate of a mile a minute. Each of the spheres has a floor and is equipped as a laboratory.

The apparatus was designed to study the atom, the nucleus of which is about one one-millionth the diameter of the atom. As the nucleus contains 99 per cent of the mass and energy of the atom it is of great interest to science. The energy in the central part is about 5,000,000 volts and if the atom is to be broken up voltages as large as this must be obtained. When work was started in this field there was available currents of only 500,000 volts, and construction of some kind of generator to make voltages of at least 5,000,000 volts was found necessary. This apparatus was de-

signed and built at Round Hill. It generates currents ranging from 5,000,000 volts to 10,000,000 volts (the maximum has not yet been attained) and a power output of about 10 kilowatts.

A vacuum tube connects the two balls and it is through this that the current travels. The current must travel through this in order that it will not dissipate and lose its velocity. During an experiment men will work within the two balls. In one ball a man will operate a low voltage electric arc which supplies either electrons or protons which are used as bullets. These bullets are carried along the vacuum tube at a velocity of about 100,000 miles per second by the high voltage current and are aimed at some target such as lithium. When the bullets hit the target the atoms of the target will be changed. Lithium has thus been changed to helium and much energy has been given out during the change. Artificial radio activity and new kinds of radiation called positive electrons and neutrons have also been produced by the bombardment of elements by these bullets.

SECTIONS AND BRANCHES

The first meeting of the **University of Detroit Branch** of the Society was held at 10:15 o'clock on Monday morning, December 17, 1934. Present: Messrs. B. N. Blakeslee, Coles, Freund, Godfrey, Hanson, C. C. Johnston, Mayrose, Oliver, Tapy.

1. Objects for the University of Detroit Branch of the Society for the Promotion of Engineering Education were adopted as follows: The position of the Society for the Promotion of Engineering Education as explained in the Constitution of the Society, and in addition to explain and discuss projects and developments in the College of Engineering of the University of Detroit and in the University; to permit members of the branch to address their fellows on matters pertaining to the profession, the College of Engineering or the University; to promote in every way possible the well-being of the College of Engineering, of the faculty and of the students.

2. Offices for the branch were established as follows: President, Vice-president and Secretary.

3. Officers were thereupon elected as follows: President, C. J. Freund; Vice-president, B. N. Blakeslee; Secretary, H. E. Mayrose.

4. It was determined that officers shall be elected for a term of one year, the elections to be held in December and the officers to assume office in January.

5. It was determined, moreover, that no member shall hold office more than one year in succession.

6. The Secretary was instructed to write to the Secretary of the Society for the Promotion of Engineering Education, presenting formal application for the establishment of a branch of the Society for the Promotion of Engineering Education for the College of Engineering of the University of Detroit, and to enclose with this application a copy of the minutes of this meeting. Also, the Secretary is to send to the Headquarters of the Society a copy of the minutes of proceedings of all meetings.

The second meeting of the **University of Detroit Branch** of the S. P. E. E. was held at 4 P.M., Tuesday, December 18, 1934. All members of the society at the University of Detroit were present, and all other members of the faculty of the College of Engineering attended.

1. Regular meetings will be held on the third Tuesday of each month, September to May, inclusive, at 4 P.M.

2. Fr. Paul D. Sullivan, S.J., Dean of the College of Arts and Science and Chairman of the Graduate Council, explained the general policy of the University and its relation to the objectives of the various colleges of the university.

H. E. MAYROSE,
Secretary

The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FREDERIC G. HIGBEE, EDITOR

Space relationships: Quite apart from its recognized value as a means of teaching engineering students the fundamentals of the scientific method, as training in the ability to visualize, and as a correlating influence between graphics and analysis, descriptive geometry, for those acquainted with its method, has practical value in solving problems in space relationship.

Engineering problems involving a three dimensional relation are usually stated graphically as a part of some design or drawing board set up, or as a calculation which may be reduced to a graphical expression. An understanding of the principles of descriptive geometry—in whatever guise or disguise it is taught—not only enables the engineer to put his problem into graphical form but also permits him to establish, analyze, and *display* the true relationship under investigation. This well explains why the term *descriptive* geometry is so appropriate.

When it is recalled that problems involving three dimensions are complicated and difficult to work by calculation, and on the contrary simple and easy to solve by the graphic method, the importance of descriptive geometry as a tool for engineers can not be overemphasized. Too much emphasis has been given to what many writers call "the practical applications" in an attempt to secure and hold the interest of students, and too little regard has been shown not only for the educational by-products but also for the tremendous additional value this geometry has by virtue of its capacity to display and quantitatively to measure space relationships.

Great interest and attention has always been given to that part of the subject concerned chiefly with the display element; why should not even greater interest and attention be given to that part of the subject by means of which the quantitative values of these displays may readily be determined? Designers, builders, and operators all have need for such a tool, and facility in its use promotes their effectiveness.

BOOK REVIEWS

Electric Power Metering. A. E. KNOWLTON. 340 pages. McGraw Hill Book Co. Price, $4.00.

The author of this new book has completed what I believe is the first successful attempt at writing a text book treating the problems and fundamental principles involved in Electric Power Metering.

The book is divided into 17 chapters, with chapter headings such as: "Evolution of the Watthour Meter," "Technique of Meter Testing," "The Polyphase Meter," "Reactive Metering," "Accuracy of Reactive Metering," "Symmetrical Components," "Demand Metering," etc. Thirteen of the chapters have a generous list of problems suggested at the end of the chapter for the student's use in order that he may apply the fundamentals. There are a total of 101 problems listed in the book.

The author has supervised short courses, for electrical meter engineers, at Yale University for several years; he has served on meter committees of the former National Electric Light Association; also he has conducted the standardizing and supervisory Laboratory of the Connecticut Public Utilities Commission. In view of these varied experiences, the information which is so well written into this book should be most authentic and reliable.

The book should be applicable to classroom use for junior and senior engineering students who are interested in electrical meters.

R. C. GORHAM

Handbook of Chemistry. Compiled and edited by NORBBERT ADOLPH LANGE, assisted by GORDON M. FORKER. Mathematical Tables and Formulas by RICHARD STEVENS BURINGTON. Published by Handbook Publishers, Inc., Sandusky, Ohio. 1934. First edition. Pages 1545. Price, $6.00.

This handbook presents all the customary data with additions which broaden its scope and at the same time increase its value to those working in industrial fields. A section is given on hazardous chemicals and their handling. Tables are given for the milk and water chemist. The food tables include vitamin content. Tables giving the physical constants of alkaloids and glucosides are presented. The arrangement of certain well known data has been improved and made more useful, for example, a listing of Organic

Solvents in the order of their boiling points, of liquids in order of increasing indices of refraction, and of organic compounds in the ascending order of their melting points. The section giving gravimetric factors and logarithms has a new and easily used form. The mathematical tables are given as a final and separate section.

The type is clear. The transparency of the paper is slight. The spacing and presentation of the material on the page makes it easily read and the size of the book makes it easy to handle.

M. L. DODDS

Practical Mine Development and Equipment. LUCIEN EATON. New York, McGraw-Hill Book Company. 1934. 405 pages. $5.00.

This work is similar in some respects to text books on mining that have appeared in recent years. A chapter is devoted to each of the following subjects: shafts, level development, mining system, shaft sinking equipment, rock drills, explosives, mechanical loading, timbering, air compressors, transportation, skips and cages, caging and loading devices, hoists, headframes, drainage, ventilation, waste disposal, change houses, shops, accident prevention. It will be evident from the list that the field has been quite fully covered. The book is unique, however, in the method of treatment, omitting material of mere historical interest and giving little space to formulas or other mathematical detail. The practical quality suggested by the title rests on the limitation of subject matter to equipment and methods of current application only. The numerous illustrations are all prepared from drawings, thus being especially clear, and many of them are dimensioned.

If any chapters may be singled out for special mention, they should be those on mining system and mechanical loading. Although both are necessarily brief in comparison with the ground that they cover, there is an unusually large amount of timely and useful material included under the respective headings.

The substance of the volume is largely drawn from the author's own extensive experience in the Lake Superior Iron Country and in many other parts of the world, but the accounts of practice in still other mining districts are equally authentic. Although the direct treatment is restricted to ore production, the fundamental principles involved are of universal application in mining.

Altogether, the book is a valuable contribution to the literature of present-day mining practice.

R. M. BLACK